

# THE WORLD COMES HERE TMS 2019

148<sup>th</sup> Annual Meeting & Exhibition

March 10–14, 2019

Henry B. González  
Convention Center  
San Antonio, Texas, USA

#TMSAnnualMeeting

## CONFERENCE GUIDE

General Meeting Information, Maps, Programming  
Highlights, and Exhibit Directory Inside



### NEED A COPY OF THE TECHNICAL PROGRAM?

Download the TMS2019 Mobile App (see page 15 for details)  
or pick up a print copy at the TMS Member Welcome Center.



[www.tms.org/TMS2019](http://www.tms.org/TMS2019)

# Thermo-Calc Software

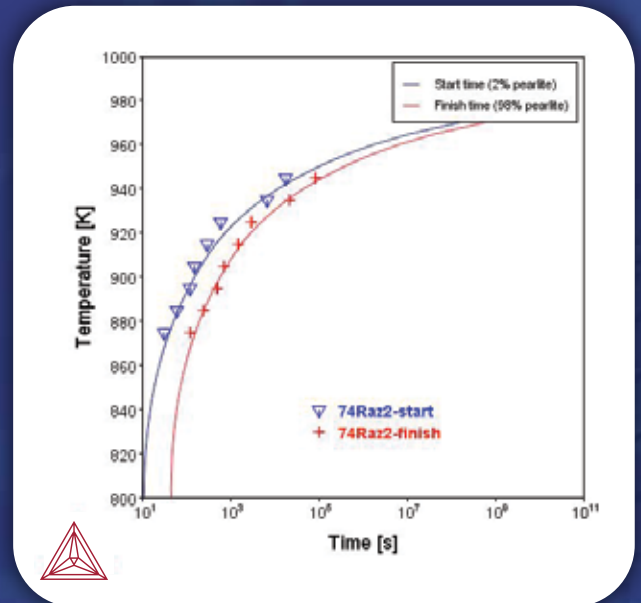
Powerful Software for Thermodynamic and Diffusion Calculations

## Software packages:

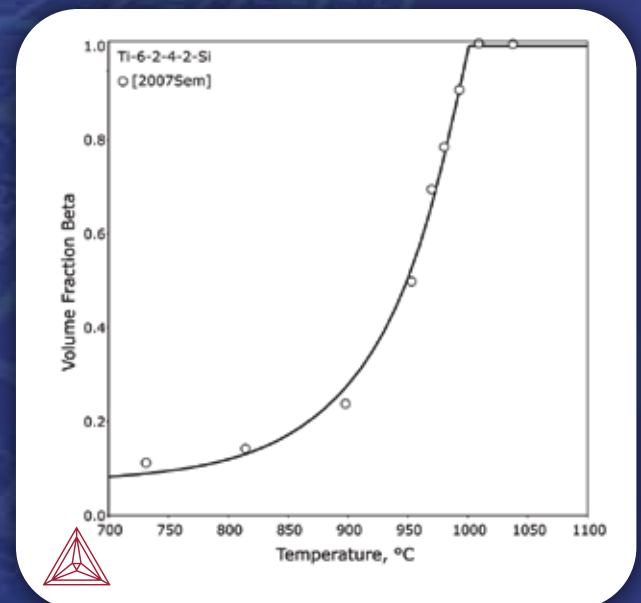
- ✓ **Thermo-Calc** for thermodynamics and phase equilibria in multicomponent systems
- ✓ **Diffusion module (DICTRA)** for modelling diffusion controlled transformations
- ✓ **Precipitation module (TC-PRISMA)** for modelling precipitation kinetics
- ✓ **Software development kits** for linking Thermo-Calc to your own software codes
- ✓ **Over 40 Databases** for thermodynamic and mobility applications

## Highlights for 2019a:

- ✓ **New Martensite + Pearlite Models** - calculate  $M_s$  and  $M_f$  temperatures and predict pearlite growth kinetics
- ✓ **New TC-Python API** - link Thermo-Calc, DICTRA, and TC-PRISMA to other packages using easy to learn Python language
- ✓ **New Databases TCT12, TCNI9, TCAL6** - Major updates to the Titanium, Nickel, and Aluminum thermodynamic and their corresponding mobility databases



TTT Diagram for pearlite formation in a eutectoid steel with 2wt% Mn



Beta approach curve for Ti-6-2-4-2

## Thermo-Calc 2019a now available:

Visit [www.thermocalc.com/release](http://www.thermocalc.com/release) to learn about the new features and databases or stop by Booth 312 at the TMS 2019 Annual Meeting and Exhibition (March 11-13, 2019)

[www.thermocalc.com](http://www.thermocalc.com)

[info@thermocalc.com](mailto:info@thermocalc.com)



Thank you for joining us for the highlight of the TMS year: the TMS 2019 Annual Meeting & Exhibition (TMS2019). For one week, TMS brings together minerals, metals, and materials scientists and engineers from around the world to present research, exchange ideas, and engage in face-to-face conversation with peers, mentors, clients, and friends. The world of our profession truly does come together here, and I'm so glad you've decided to be a part of it.

Before you dive into an action-packed schedule of events, allow me to briefly share a few highlights of this year's conference, as well as a few practical tips for making the most of your time here.

**MONDAY ALL-CONFERENCE PLENARY FEATURES LUANA IORIO**

From noon to 1:00 p.m. on Monday, Luana Iorio of GE Aviation will deliver an all-conference plenary talk on the topic "The Next Materials Frontier for Flight." Join your fellow TMS2019 attendees for this broad-interest presentation that will bring together attendees from all technical disciplines for a shared experience.

Afterwards, you are invited to browse the GE additive technologies related to Iorio's talk on display in the lobby and to join your fellow conference attendees for lunch in the Exhibit Hall. (Check the tickets attached to your badge for your complimentary lunch tickets.)

**TMS2019 WELCOMES REWAS 2019**

The REWAS 2019 symposium, the sixth installment in this conference series, will be held in conjunction with TMS2019 and will focus on the topic Manufacturing the Circular Materials Economy. All TMS2019 attendees are welcome to attend the five symposia that make up REWAS, as well as Tuesday morning's REWAS plenary session featuring seven invited speakers and the International Round Table on Materials Criticality to be held on Thursday.

**DGM TEAMS WITH TMS ON LIGHT METALS**

TMS welcomes The German Materials Society (DGM) as a programming partner for 2019. The TMS-DGM Symposium on Lightweight Metals: A Joint U.S.-European Symposium on Challenges in Light Weighting the Transportation Industry will be held on Tuesday, with a session devoted to aluminum in the morning and one devoted to magnesium in the afternoon.

**PLAN YOUR WEEK WITH SCHEDULING TOOLS**

With more than 3,500 presentations planned for TMS2019, determining what to attend and how to find your next location can be daunting. Here are some steps to make getting around easier: First, download the TMS2019 App for your mobile device. It includes maps and a scheduling tool that may prove a valuable and convenient way to structure your week. Second, make use of the TMS2019 maps strategically placed throughout the convention center.

**WHERE DO I FIND THE TECHNICAL PROGRAM?**

Those of you who are frequent TMS annual meeting attendees may have noticed that the conference guide in your hands is significantly slimmer than in past years. This is because it does not include the full technical program with its listing of more than 3,500 presentations. If you would like a print version of the complete technical program, you can pick one up at the TMS Member Welcome Center, located near registration. The program is also available electronically through the TMS2019 app and as a downloadable, interactive PDF at [www.tms.org/TMS2019](http://www.tms.org/TMS2019).

**VISIT THE TMS MEMBER WELCOME CENTER**

Please take a few minutes to meet some of the TMS staff at the TMS Member Welcome Center, which is located near Registration. If you are a first-time attendee or someone who has attended ten or more consecutive TMS annual meetings, please stop by to pick up your free gift. All other attendees should visit to pick up their 2019 commemorative pin. Staff will also be happy to assist you with any questions that you might have about TMS2019, including downloading and using the TMS2019 app, as well as questions regarding your membership.

**MAKE THE MOST OF YOUR WEEK!**

In the session rooms each day, you're guaranteed to gain new insights on your work, learn about different approaches to common problems, and generally expand your knowledge in a wide variety of areas. I hope you use this newfound knowledge to advance your own work and that you return from your week with us energized and ready to take on new challenges.

I wish you a productive and exciting week at TMS2019!

Sincerely,

Kevin J. Hemker  
2018 TMS President



# TABLE OF CONTENTS

President's Welcome Message .....	1	Keynote & Featured Sessions .....	32
TMS2019 Location Maps .....	2	A Deeper Look at Study Findings .....	38
Emergency Procedures .....	11	TMS Technical Division Honorary Symposia.....	40
Registration & Tickets .....	12	Special Lectures .....	42
Proceedings Information .....	13	Leadership & Professional Skills .....	46
Wi-Fi, Food & Business Services .....	14	Networking & Social Events .....	48
News & Meeting Updates .....	15	Student Events .....	49
Member Services & Information .....	16	2019 TMS Bladesmithing Competition.....	50
Meeting Policies.....	17	2019 TMS-AIME Awards Ceremony & Banquet ...	52
		2018-2019 TMS Board of Directors .....	58
<b>CALENDAR OF EVENTS</b>			
Saturday .....	19	<b>2019 EXHIBIT DIRECTORY</b>	
Sunday .....	19	Exhibit Hours .....	59
Monday .....	21	Exhibiting Companies .....	60
Tuesday .....	23	Exhibition Floorplan .....	61
Wednesday.....	24	Exhibit Directory by Product Category .....	62
Thursday .....	25	Exhibiting Company Descriptions.....	64
		Conference Sponsors.....	72
Technical Committee Schedule .....	26	Technical Program At-A-Glance .....	73
All-Conference Plenary Session .....	28	Upcoming TMS Meetings.....	88
REWAS 2019 .....	30		



## VIEW THE FULL TECHNICAL PROGRAM

For complete details on technical symposia and presentations:

- Search the "Schedule" section of the TMS2019 app
- Download an interactive PDF of the technical program at [www.tms.org/TMS2019](http://www.tms.org/TMS2019)
- Pick up a copy of the complete printed technical program at the TMS Member Welcome Center



## DAYLIGHT SAVINGS TIME

Daylight savings time begins at 2:00 a.m. on Sunday, March 10.



San Antonio, TX, USA  
**12:00 p.m.**  
 (UTC-5)  
 March 10, 2019



New York, USA  
**1:00 p.m.**  
 (UTC-4)  
 March 10, 2019



Beijing, China  
**1:00 a.m.**  
 (UTC+8)  
 March 11, 2019



Brussels, Belgium  
**6:00 p.m.**  
 (UTC +1)  
 March 10, 2019



Greenwich Mean Time  
**5:00 p.m.**  
 (UTC +0)  
 March 10, 2019



SAN ANTONIO GUIDE  
**DOWNTOWN  
DINING & NIGHTLIFE**

\*Serves Breakfast and/or Brunch

Go to [VisitSanAntonio.com](http://VisitSanAntonio.com) for a comprehensive listing.

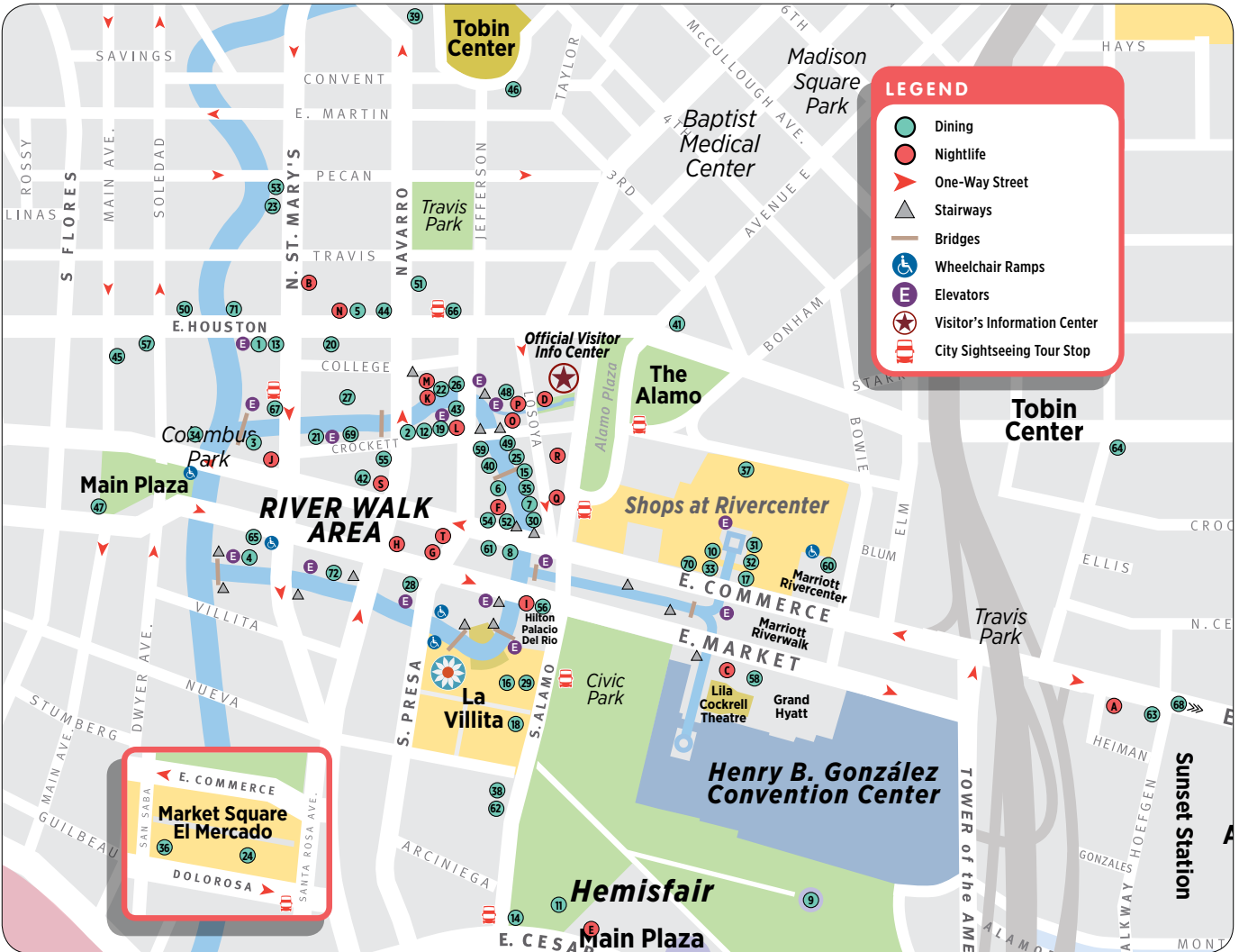
BAR / CLUB	ADDRESS	210 AREA	THEME
<b>A</b> Ash	1170 E. Commerce	253.9919	Cocktails
<b>B</b> Bar 414 @ Sheraton Gunter Hotel	713 S. Alamo	225.5550	Latin Mojito Bar
<b>C</b> Bar Rojo	600 E. Market	224.1234	Latin Mojito Bar
<b>D</b> Bier Garten	126 Losoya	221.7299	Bavarian
<b>E</b> Con Safos	607 HemisFair Plaza Way	514.5006	Bar
<b>F</b> Coyote Ugly	409 E. Commerce	465.8459	Like the movie
<b>G</b> Davenport	203 N. Presa	224.5635	Upscale bar
<b>H</b> Drink Texas	200 Navarro	224.1031	Cocktails
<b>I</b> Dirty Nelly's Irish Pub	200 S. Alamo	224.3343	Irish Bar
<b>J</b> Esquire Tavern	155 E. Commerce	222.2521	Tavern

BAR / CLUB	ADDRESS	210 AREA	THEME
<b>K</b> Havana Ultra Lounge	212 College	220.1973	Latin / Salsa
<b>L</b> Howl at the Moon	1111 W. Crockett	212.4770	Piano Bar
<b>M</b> Kremlin	212 College	220.1972	70's / 80's / 90's
<b>N</b> The Last Word	229 E. Houston #10	314.1285	Craft Cocktails
<b>O</b> Mad Dog's British Pub	123 Losoya #19	222.0220	British Pub
<b>P</b> On the Bend	123 Losoya #7	354.3002	Oyster Bar
<b>Q</b> On the Rocks Pub	270 Losoya	228.0000	Pub
<b>R</b> Pat O'Brien's	121 Alamo Plaza	220.1076	New Orleans Legend
<b>S</b> Scho Wine & Martini Bar	214 W. Crockett	444.1000	Cocktails / Cigar
<b>T</b> Zinc Wine Bar	207 N. Presa	224.2900	Wine & Cigar

RESTAURANT	ADDRESS	210 AREA	THEME
<b>1</b> Acenar	146 E. Houston	222.2362	Latin/Tex-Mex
<b>2</b> Barriba Cantina	111 W. Crockett #214	228.9876	Tex-Mex
<b>3</b> Bella On the River	106 River Walk	404.2355	Mediterranean
<b>4</b> Biga on the Banks	203 S. St. Mary's	225.0722	Gourmet/Fine Dining
<b>5</b> Bohanan's	219 E. Houston	472.2600	Prime Steak/Seafood
<b>6</b> Boudro's	421 E. Commerce	224.8484	Texas Bistro
<b>7</b> Café Ole	521 River Walk	223.2939	Mexican
<b>8</b> Casa Rio	430 E. Commerce	225.6718	Mexican
<b>9</b> Chart House	739 E. Cesar E. Chavez	223.3101	Steak/Fine Dining
<b>10</b> Chili's	849 E. Commerce #109	212.8152	American
<b>11</b> CommonWealth Coffeehouse & Bakery	611 HemisFair	686.4844	Coffee/Café
<b>12</b> County Line	111 W. Crockett #104	229.1941	BBQ
<b>13</b> Dornegos*	150 E. Houston	230.8412	Gourmet/Fine Dining
<b>14</b> Dough Pizzeria	518 S. Alamo	227.2900	Italian
<b>15</b> Dick's Last Resort	223 Losoya	224.0026	American
<b>16</b> Fig Tree	515 Villita	224.1976	Gourmet/Fine Dining
<b>17</b> Fogo de Chão	849 E. Commerce	227.1700	Brazilian Steakhouse
<b>18</b> Guadalajara Grill	301 S. Alamo	222.1992	Mexican/American
<b>19</b> Hard Rock Café	111 W. Crockett	224.7625	American
<b>20</b> Houston Street Bistro	204 E. Houston	476.8600	Continental
<b>21</b> Iron Cactus	200 River Walk #100	224.9835	Mexican
<b>22</b> Joe's Crab Shack	212 College #100	271.9981	Seafood
<b>23</b> Kimura	152 E. Pecan #102	444.0702	Japanese
<b>24</b> La Margarita	120 Produce Row	227.7140	Mexican/Oyster Bar

RESTAURANT	ADDRESS	210 AREA	THEME
<b>25</b> La Paloma Riverwalk	215 Losoya	212.0566	Tex-Mex
<b>26</b> Landry's	517 N. Presa	229.1010	Seafood
<b>27</b> Las Canarias*	112 College	518.1063	Gourmet/Fine Dining
<b>28</b> Las Ramblas*	306 W. Market	298.8040	Spanish
<b>29</b> Little Rhein Steak House	231 S. Alamo	225.2111	Steak/Fine Dining
<b>30</b> Lone Star Café	237 Losoya	223.9374	Southwestern/American
<b>31</b> Luciano	849 E. Commerce #183	223.0500	Italian
<b>32</b> Maria Mia	849 E. Commerce	272.0403	Tex-Mex
<b>33</b> Margaritaville	849 E. Commerce	973.5911	American
<b>34</b> Mexican Manhattan	110 Soledad	223.3915	Mexican
<b>35</b> Michelino's	521 River Walk	223.2939	Italian
<b>36</b> Mi Tierra Café*	218 Produce Row	225.1262	Mexican
<b>37</b> Morton's Steak House	300 E. Crockett	228.0700	Steak/Fine Dining
<b>38</b> Norma Osteria	401 S. Alamo	224.8800	Italian
<b>39</b> Ocho at Hotel Havana*	1015 Navarro	222.2008	Latin
<b>40</b> Original Mexican Restaurant*	528 River Walk	224.9951	Mexican
<b>41</b> ORD Restaurant and Bar	705 E. Houston	244.0146	American
<b>42</b> Ostra*	212 W. Crockett	396.5817	Seafood
<b>43</b> Poesanos Riverwalk	111 W. Crockett #101	222.2782	Mediterranean/Italian
<b>44</b> The Palm	233 E. Houston	226.7256	Steak/Fine Dining
<b>45</b> Pinch Boil House	124 N. Main Ave	971.7774	Seafood
<b>46</b> Pharm Table	106 Auditorium Circle	802.1860	Modern American
<b>47</b> Poblanos on Main*	115 Main Plaza	357.5609	Tex-Mex
<b>48</b> Q Kitchen   Bar*	123 Losoya	222.1234	Barbecue

RESTAURANT	ADDRESS	210 AREA	THEME
<b>49</b> Rainforest Café	110 E. Crockett	277.6300	American
<b>50</b> Range	125 E. Houston	227.4455	Steak/Seafood
<b>51</b> Rebelle	300 E. Travis	352.3171	Modern American
<b>52</b> Republic of Texas*	526 River Walk	226.6256	"Texas Style"
<b>53</b> Restaurant Gwendolyn	152 E. Pecan #100	222.1849	Gourmet/Fine Dining
<b>54</b> Rio Rio Cantina*	421 E. Commerce	226.8462	Tex-Mex
<b>55</b> Rita's on the River	245 E. Commerce #100	227.7482	Tex-Mex
<b>56</b> The River's Edge Café & Patio Bar*	200 S. Alamo	270.0786	American/South Texas
<b>57</b> Rosella at the Rand*	114 Houston	595.1410	Coffee/Restaurant
<b>58</b> Ruth's Chris Steak House	600 E. Market	227.8847	Steak/Fine Dining
<b>59</b> Saltgrass Steak House	522 River Walk	222.9092	Steak
<b>60</b> Sazo's Latin Grill*	101 Bowie	554.6180	Latin/Tex-Mex
<b>61</b> Schilo's Delicatessen*	424 E. Commerce	223.6692	Deli
<b>62</b> Silo Prime	401 S. Alamo	224.8800	Steakhouse
<b>63</b> Smoke: The Restaurant	1170 E. Commerce	253.9919	BBQ
<b>64</b> Spaghetti Warehouse	1226 E. Houston	299.1114	Italian
<b>65</b> Sushi Zushi	203 S. St. Mary's	472.2900	Asian
<b>66</b> Texas de Brazil	313 E. Houston	299.1600	Brazilian Steakhouse
<b>67</b> Texas Land & Cattle	201 N. St. Mary's	222.2263	Steak
<b>68</b> Tony G's Soul Food*	915 S. Hackberry	451.1234	American
<b>69</b> Waxy O'Connor's	234 River Walk	229.9299	Irish Restaurant/Pub
<b>70</b> Yard House	849 E. Commerce #409	354.3844	American
<b>71</b> Zocalo*	175 E. Houston #115	314.8468	Mexican
<b>72</b> Zocca*	420 W. Market	444.6070	Italian

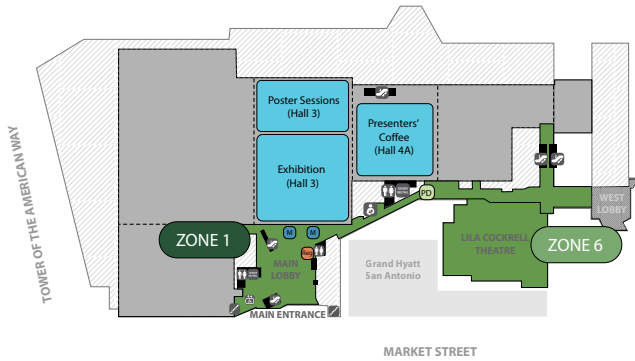


MEETING INFORMATION

# KNOW YOUR ZONE!

For the convenience of attendees, programming is generally grouped and color-coded by topic areas. Find the zones with your topic area to easily locate your session rooms on the map.

## Networking Level 100 (Street Level)



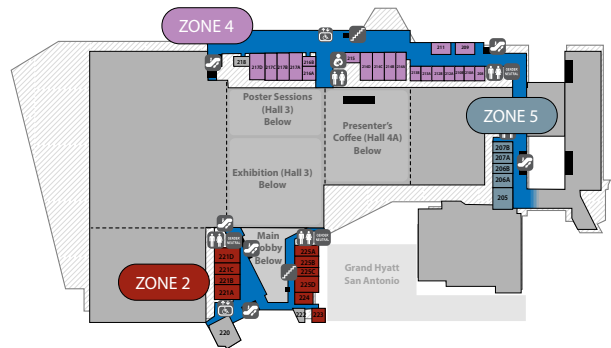
### ZONE 1

- Registration
- Exhibition
- Poster Sessions
- Member Welcome Center
- GE Technical Display

### ZONE 6

- Presenters' Coffee
- Programming Desk
- Special Topics
- Lila Cockrell Theatre

## Programming Level 200 (Main Room Level)



### ZONE 2

- Additive Technologies
- Corrosion
- Energy & Environment
- Physical Metallurgy

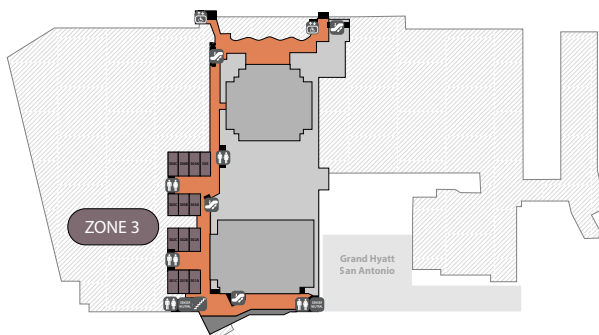
### ZONE 4

- Materials Processing
- Nanostructured Materials
- Nuclear Materials
- Corrosion
- Electronic Materials
- Biomaterials

### ZONE 5

- Advanced Materials
- Materials Design
- Energy & Environment

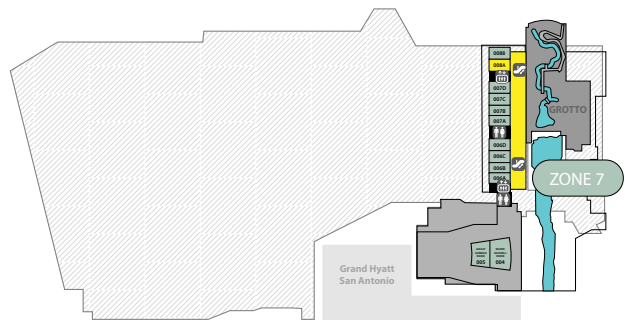
## Programming Level 300 (Ballroom Level)



### ZONE 3

- Mechanics & Structural Reliability
- Characterization
- Materials Design

## Programming Sub-Level (River Level)



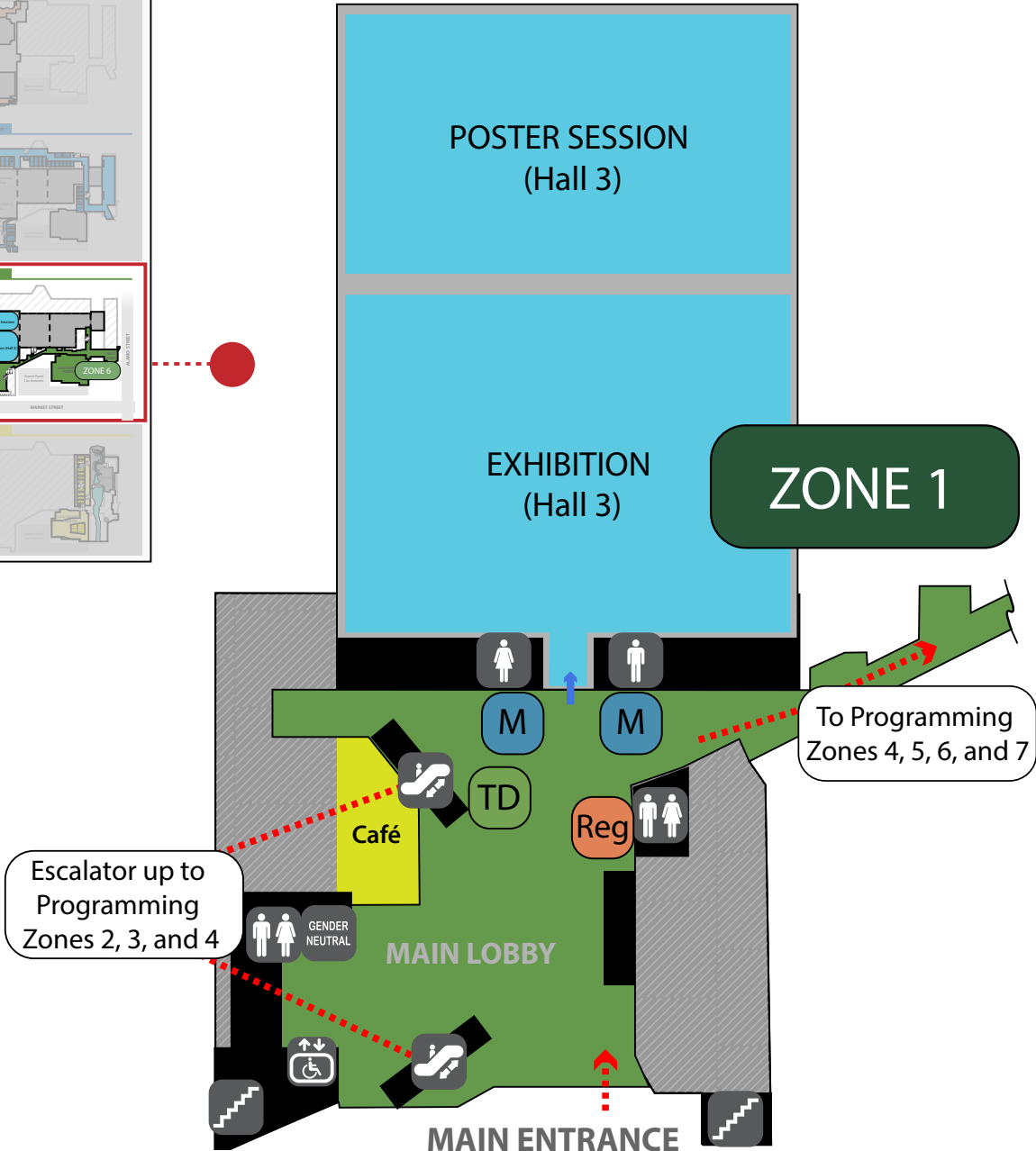
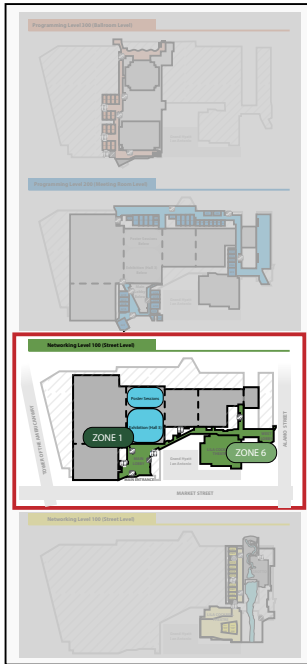
### ZONE 7

- Light Metals
- Materials Processing
- Energy & Environment

MEETING INFORMATION

Restrooms
 Mother's Room
 Elevator
 Escalator
 Stairs

Networking Level 100 (Street Level)



**ZONE 1**

To Programming Zones 4, 5, 6, and 7

Escalator up to Programming Zones 2, 3, and 4

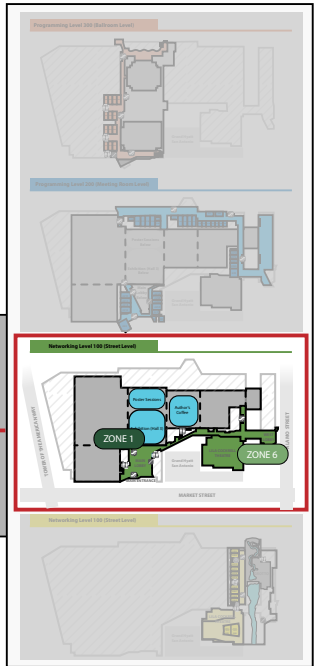
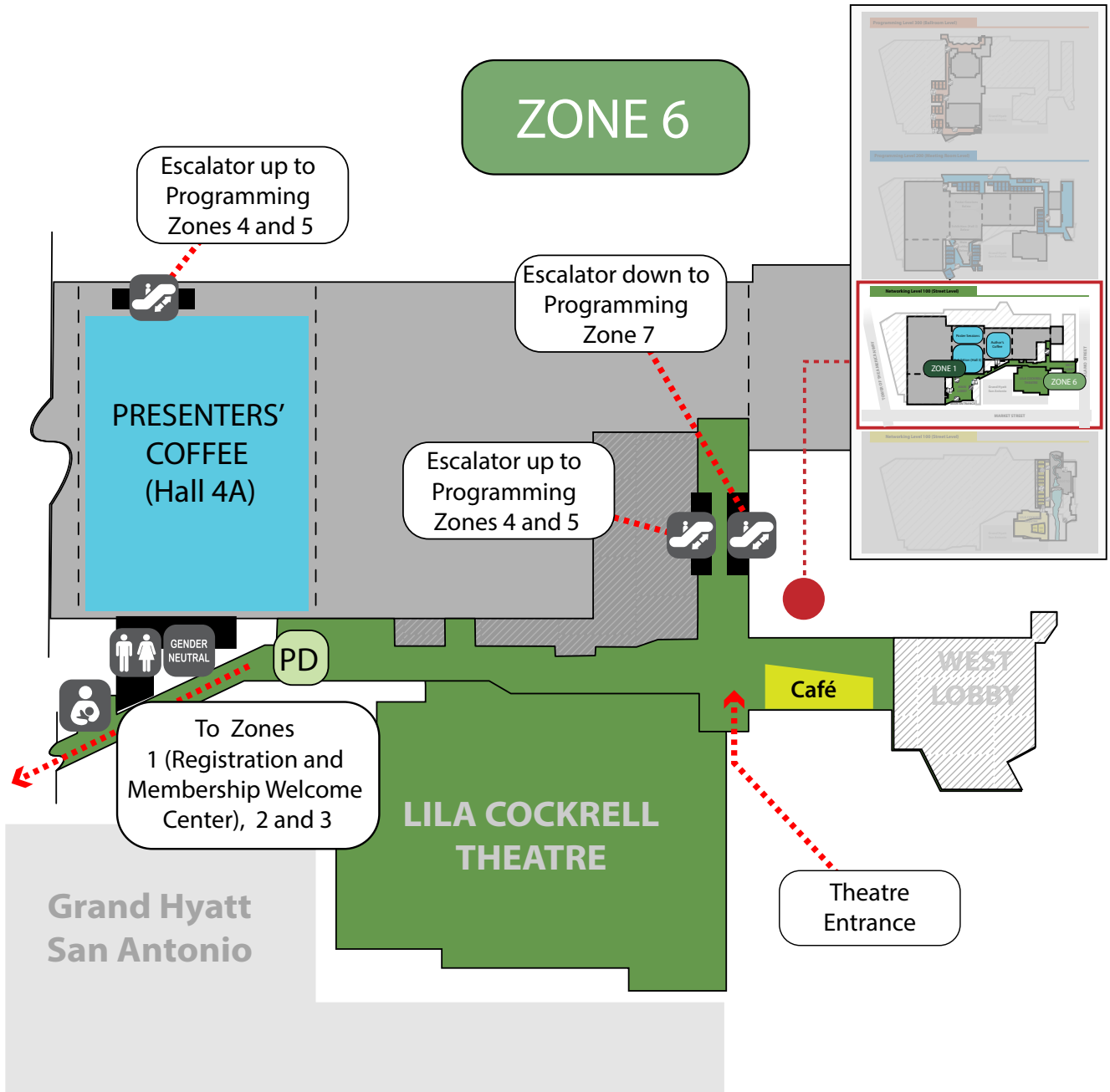
Reg Registration   
 M Member Welcome Center   
 TD Technology Display   
 PD Programming Desk

GENDER NEUTRAL Restrooms   
 Mother's Room   
 Elevator   
 Escalator   
 Stairs

MEETING INFORMATION



Networking Level 100 (Street Level)

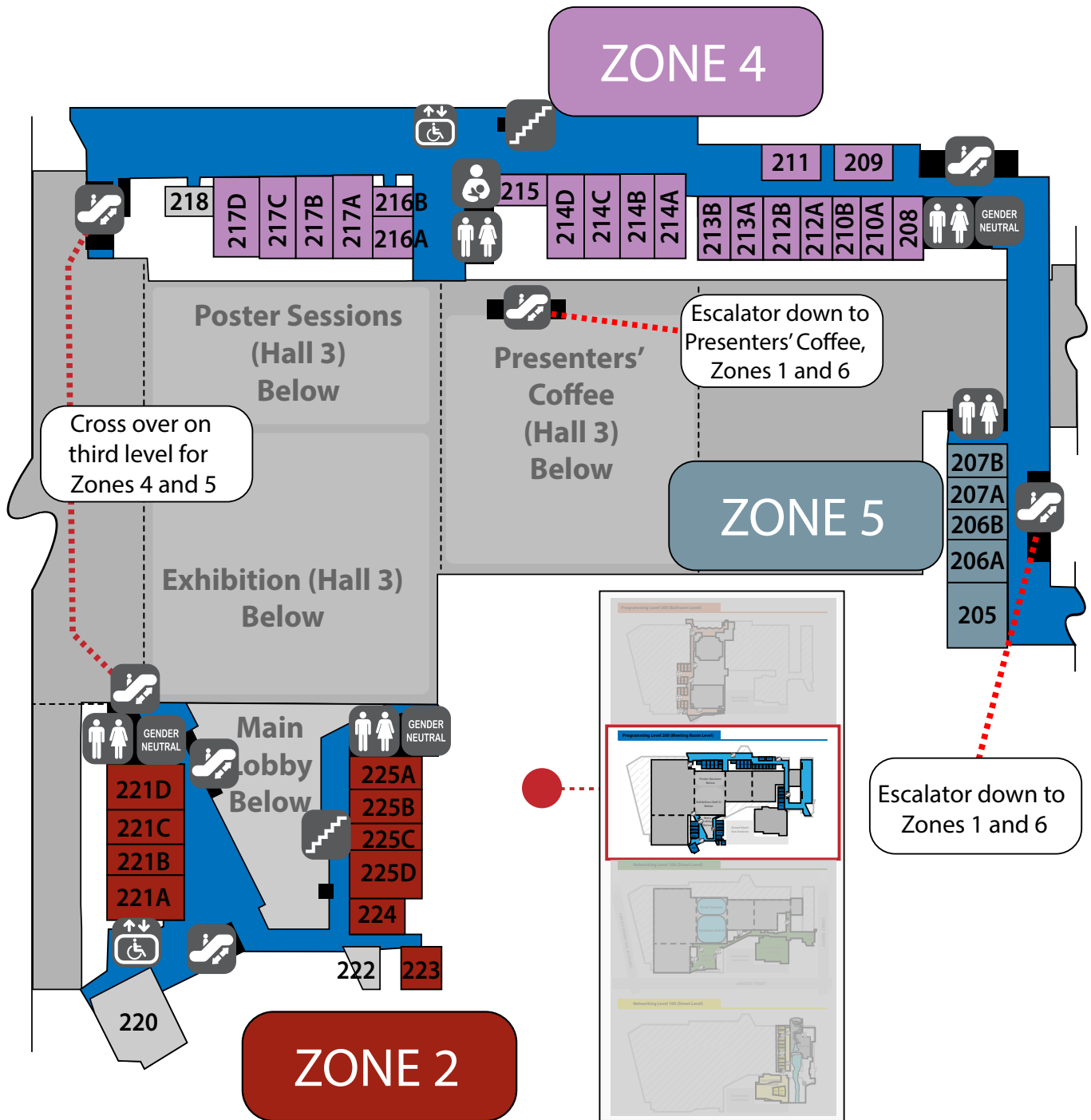


Reg Registration    M Member Welcome Center    TD Technology Display    PD Programming Desk

GENDER NEUTRAL Restrooms    Mother's Room    Elevator    Escalator    Stairs

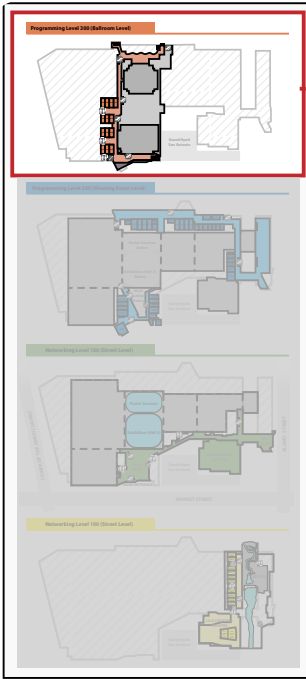
MEETING INFORMATION

Programming Level 200 (Main Room Level)

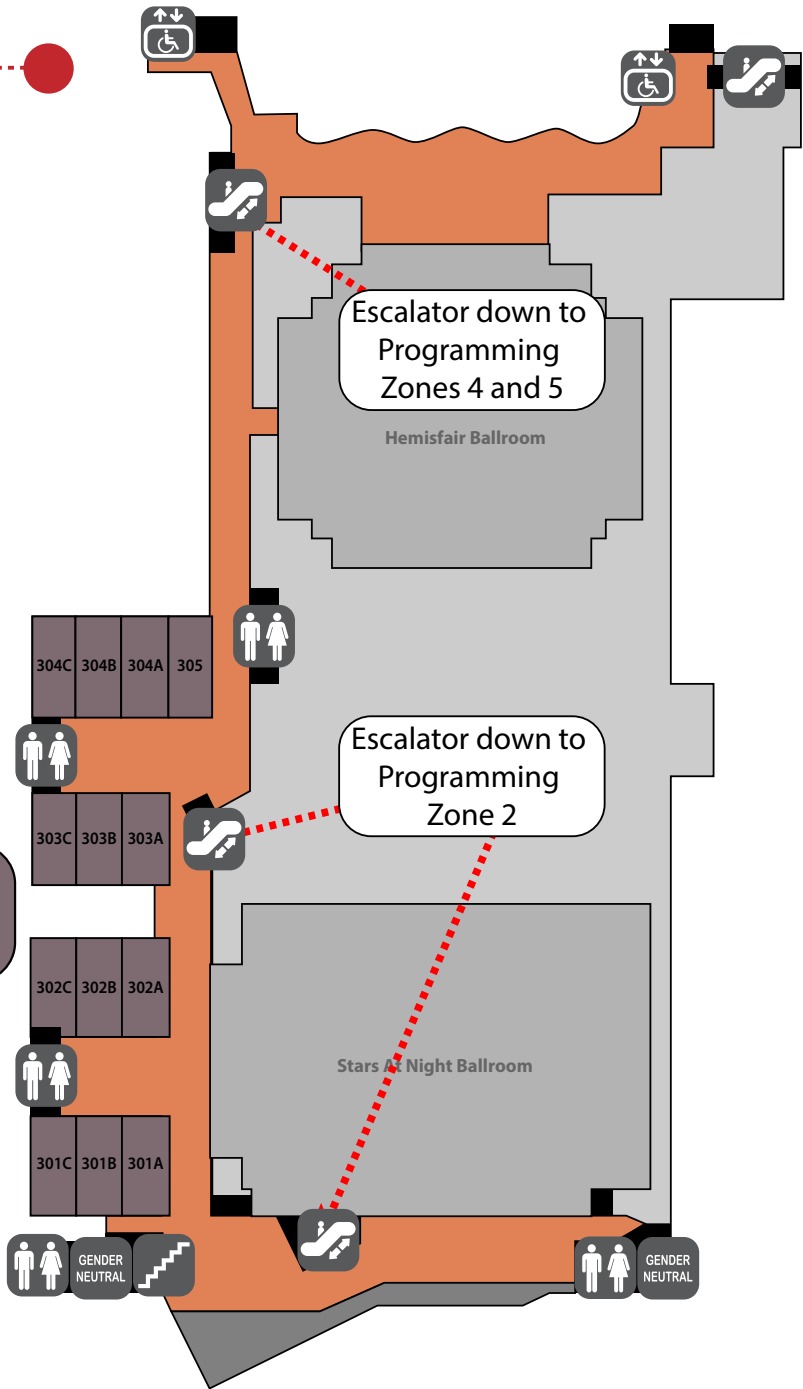


Restrooms
 Mother's Room
 Elevator
 Escalator
 Stairs

Programming Level 300 (Ballroom Level)



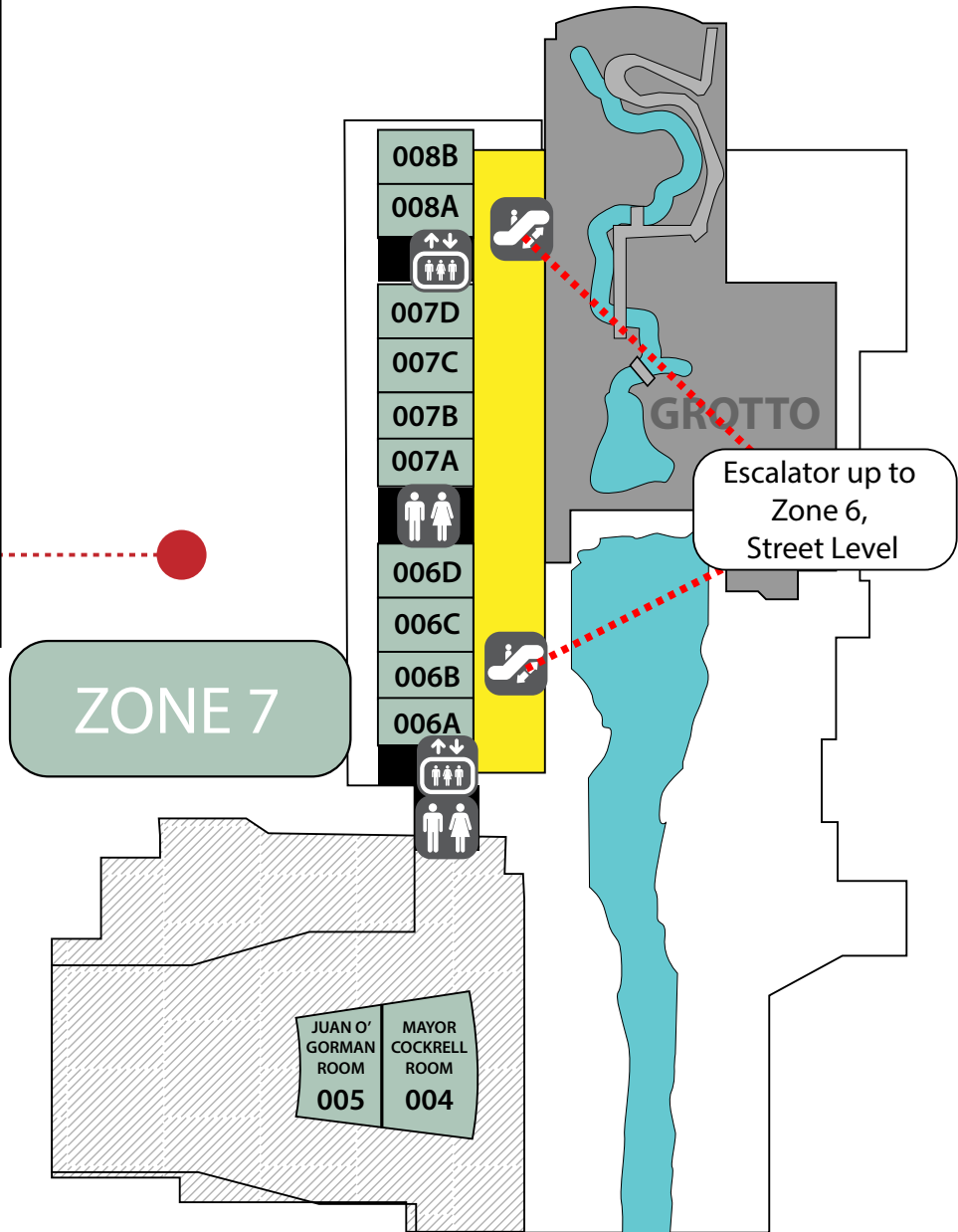
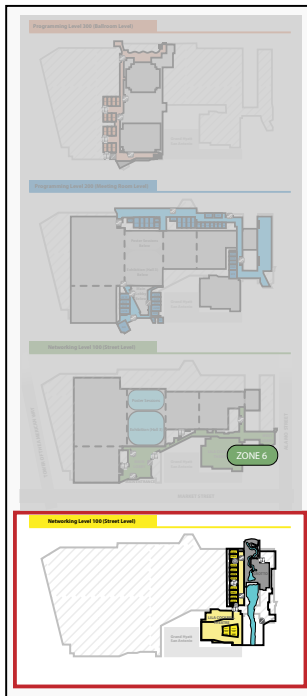
**ZONE 3**



Restrooms
 Mother's Room
 Elevator
 Escalator
 Stairs



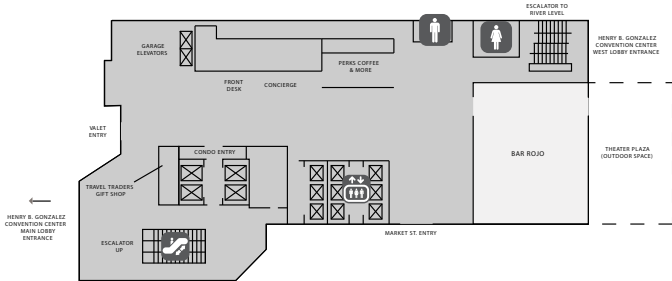
Programming Sub-Level (River Level)



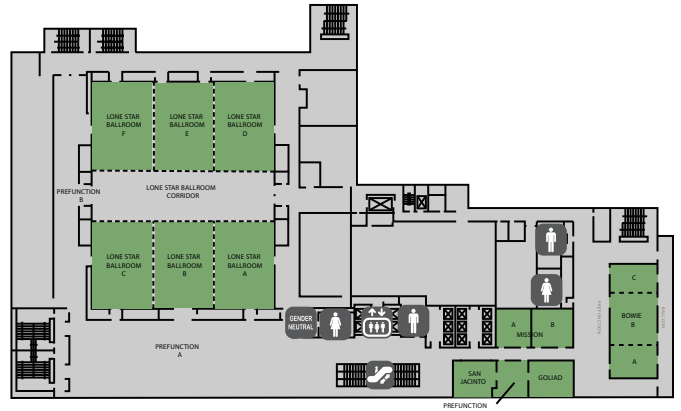
Restrooms
 Mother's Room
 Elevator
 Escalator
 Stairs

Grand Hyatt San Antonio

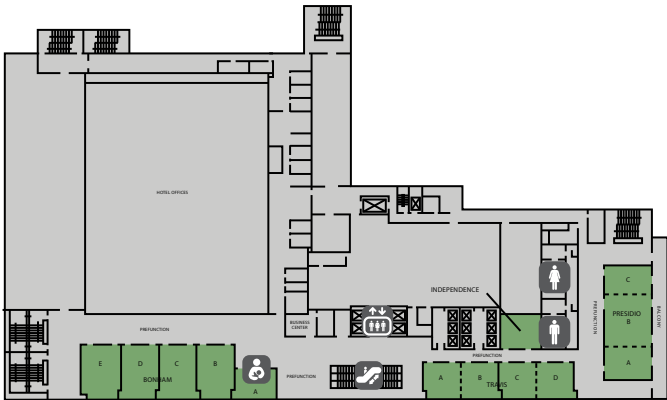
Lobby Level



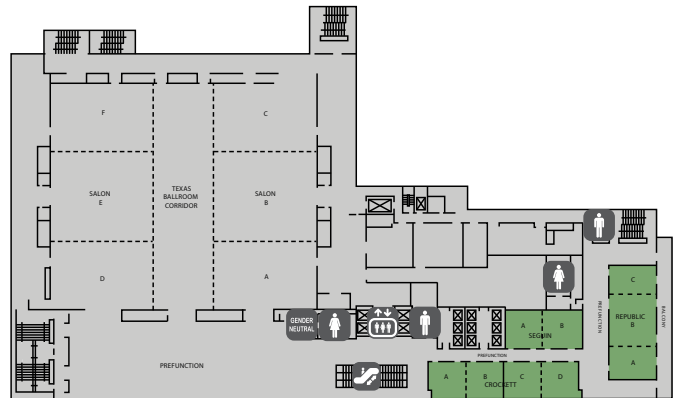
Second Floor



Third Floor



Fourth Floor



Restrooms



Mother's Room



Elevator



Escalator



Stairs



GET TO KNOW OUR HOST CITY!

Stop by the Visit San Antonio information desk for additional maps, dining guides, and visitor information. Representatives from Visit San Antonio will be on hand to answer your questions about the city.

@visitsanantonio



In the event of an emergency, being prepared to react effectively is the most critical step in ensuring the health and safety of yourself and those around you.

**KNOW YOUR SURROUNDINGS**

Please take a few moments to review the maps of the TMS2019 facilities available on pages 4-10 of this guide and on the TMS2019 App. When you enter these buildings, familiarize yourself with the exits and the stairs leading to those exits. When you arrive at your session or event location, look for the emergency exits that are in proximity to you.

**HOSPITALS AND PHARMACIES**

A listing of local hospitals and pharmacies can be found in the Attendee Toolbox section of the TMS2019 website and on the TMS2019 App.

**TAKE NOTE**

**OF LOCATIONS FOR SPECIAL SERVICES**

**NURSING MOTHER'S ROOMS**



The Henry B. González Convention Center offers two dedicated, private rooms for nursing mothers. One is located in the East Wing of the Convention Center in Room 1212 (in the lobby corridor between Halls 3 & 4). The other is located in the West Wing in Room 2137, next to Room 215 in Parkview. The rooms are equipped with comfortable furniture, power outlets, wastebasket, table, and paper towels.

At the Grand Hyatt San Antonio, the Bonham A meeting room on the third floor of the hotel will serve as the nursing mother's room for TMS2019 attendees and can accommodate two individuals at a time. A chair, table, and outlet access is available for each occupant. The room also has a water station and refrigerator.

Look for the Nursing Mother's Room icon on the map.

**GENDER-NEUTRAL RESTROOMS**



Gender-neutral restrooms are available at the Henry B. González Convention Center and at the Grand Hyatt San Antonio. Look for this icon on the map.

**EXITS AND ELEVATORS FOR ATTENDEES WITH DISABILITIES**



Exits and elevators designated for attendees with disabilities are indicated on the map with this icon.

**AT THE HENRY B. GONZÁLEZ CONVENTION CENTER**

**HOW TO REPORT AN EMERGENCY**

Courtesy phones are located within the convention center. Instructions with phone numbers are provided near each phone.

If an emergency is a **life-threatening situation**:

1. Please call 911 immediately and give as many details as possible. Notify the operator that you are a guest at the Henry B. González Convention Center, 900 E. Market St.
2. Notify in-house security at (210) 207-7773 and relay the information so that they can direct emergency personnel to the appropriate location quickly.

If it is **not a life-threatening situation**, please notify the in-house Security Division at (210) 207-7773.

**ALARMS**

Should the general alarm sound, all attendees should evacuate the building immediately. A public address system will announce instructions in English and Spanish during the alarm. For those who are hearing impaired, the alarms are fitted with strobe lights to indicate that the alarm was activated.

**EMERGENCY EVACUATIONS**

In the event of an emergency evacuation, attendees should leave the convention center through the nearest exit and remain outside until instructed to re-enter. Assistance will be provided to guests with disabilities. Exits and elevators designated for attendees with disabilities are indicated on the maps in this conference guide and on the TMS2019 App.

**AT THE GRAND HYATT SAN ANTONIO**

**HOW TO REPORT AN EMERGENCY**

From any house phone, dial extension 55 for the hotel emergency team. For hotel security, dial extension 6222 or 210-451-6222.

**ALARMS**

If an alarm is activated, follow the announcement from the public address system instructing you what action should be taken.

**EMERGENCY EVACUATIONS**

In the case of an emergency evacuation, follow the instructions of the hotel staff and proceed to the nearest emergency exit/stairwell. Follow the evacuation route out of the building to a designated assembly area. At the assembly area, please inform a hotel staff member of your room number and whether you require medical attention. Guests with disabilities should dial extension 55 if they need assistance. At check-in, inform the front office host if you will need assistance evacuating so that the hotel can keep record of it.



## REGISTRATION & TICKETS

### REGISTRATION BADGES

The TMS2019 name badge you received at registration must be worn for admission to technical sessions, the exhibit hall, social functions, and other events. Your full-meeting registration badge provides you access to:

- More than 80 symposia in 15 technical tracks
- Technical sessions of REWAS 2019
- A three-day pass to the TMS2019 Exhibition:
  - Exhibit Hall Opening Reception and Poster Session
  - Exhibit Hall Happy Hour and Poster Session
- President's Welcoming Reception
- All-conference plenary session, featuring Luana Iorio, GE Aviation
- 2019 TMS-AIME Awards Ceremony
- Online access to the complete collection of TMS2019 proceedings publications

Attached to your name badge, you will find tickets that allow you access to select functions at TMS2019.

### BADGE REPLACEMENT

Please keep your badge with you at all times during the meeting. If you misplace your badge, replacement badges can be printed at the TMS2019 registration desk for a fee of \$25.

### TICKETED EVENTS

Certain receptions, luncheons, and other activities at TMS2019 require purchase of a ticket in order to attend. If you purchased tickets in advance for one of these events, your ticket will be attached to your name badge. If you would like to add a ticketed event to your registration, please inquire at the registration area.

Most ticket sales will be closed by 10:00 a.m. the day before the event. For example, tickets for the awards banquet on Wednesday evening should be purchased by 10:00 a.m. on Tuesday. An exception is the Fresh Coffee, Fresh Ideas: Diversity and Inclusion Breakfast on Wednesday morning. Ticket sales for this event will close at 5:00 p.m. on Monday.

#### Registration Desk - Hours of Operation:

Sunday: 7:00 a.m. to 7:00 p.m.  
Monday: 7:00 a.m. to 6:00 p.m.  
Tuesday: 7:00 a.m. to 5:30 p.m.  
Wednesday: 7:00 a.m. to 5:00 p.m.  
Thursday: 7:00 a.m. to 2:00 p.m.

**Goodfellow**  
Your global supplier for materials™

Where **MATERIALS KNOWLEDGE**  
& **INNOVATION** meet



Metals



Alloys



Ceramics



Polymers



Composites



Compounds

[www.goodfellowusa.com](http://www.goodfellowusa.com) / [info@goodfellowusa.com](mailto:info@goodfellowusa.com) / 1-800-821-2870

**FREE PROCEEDINGS ACCESS**

TMS2019 attendees in most registration classes receive free online access to the complete collection of proceedings publications. For details on how to download the proceedings publications, see the instructions attached to your name badge.

**INDIVIDUAL VOLUMES FOR PURCHASE**

TMS members receive a 40% discount off hard copies of the TMS2019 proceedings volumes presented on this page. These books will be available for purchase at the Springer booth, located near the TMS2019 registration area at the Henry B. González Convention Center.

Please note that complimentary proceedings content must be downloaded by April 30, 2019, at which time standard pricing will take effect.

Visit the online TMS Bookstore to search the complete inventory of available TMS publications, including past proceedings volumes at [www.tms.org/Bookstore](http://www.tms.org/Bookstore).

**TMS2019 PROCEEDINGS VOLUMES**

The following volumes will be included in the online proceedings content access for most registrants, and hard copies will be available for purchase at TMS2019:



## Wi-Fi, FOOD & BUSINESS SERVICES

### Wi-Fi ACCESS

For your convenience, free wireless internet access will be available in all areas of the Henry B. González Convention Center. To access free Wi-Fi:



Choose Network:  
**TMS2019**  
Enter Password:  
**materials**

### LUNCHES

Tickets for lunches in the TMS2019 Exhibit Hall (included as part of the conference registration fee) are attached to each full-conference attendee's name badge. Please take advantage of these complimentary lunches as a convenient option during busy days. Lunch will be available in the exhibit hall at the following days and times:

**Monday, March 11**  
1:00 p.m. to 2:30 p.m.

**Tuesday, March 12**  
11:30 a.m. to 1:30 p.m.

**Wednesday, March 13**  
11:30 a.m. to 1:30 p.m.

### COFFEE AND QUICK BITES

On Thursday, when lunch is not available in the exhibit hall, attendees can visit Market Café (in the Main Lobby) or El Puente (in the West Lobby) for a convenient lunch without leaving the convention center. These are also good food service options for attendees looking for a drink, a snack, or a quick meal.

#### Market Café (located in Main Lobby)

Hours: 7:00 a.m. to 4:00 p.m. daily  
Market Café has a selection of Starbucks coffees, chilled beverages, snacks, salads, cold sandwiches, hot sandwiches, pizzas, as well as Barbosa (a bar that opens around noon).

#### El Puente (located in West Lobby)

Hours: 7:00 a.m. to 4:00 p.m. daily  
El Puente has a selection of Starbucks coffees, chilled beverages, snacks, salads, and cold sandwiches.

For more information on convention center and local area dining and maps, see the "Around Here" section of the TMS2019 App or visit the Travel page of the TMS2019 website at [www.tms.org/TMS2019](http://www.tms.org/TMS2019).

### BUSINESS SERVICES

A UPS store is located in the lobby of the Henry B. González Convention Center, Street Level, at the main entrance. Attendees and exhibitors can use the UPS Store to ship, mail, fax, photocopy, or create a last-minute presentation. The store is closed on Sunday, but open Monday through Friday, 8:00 a.m. to 6:30 p.m.



## 2019 MATERIALS BOWL COMPETITORS

Stop by the Lila Cockrell Theatre between 2:00 p.m. and 6:00 p.m. on Sunday afternoon to cheer on your favorite school at the TMS Materials Bowl. The teams competing in this year's event are:

- University of North Texas, "Aluminati"
- University of Florida, "The Bowl Gators"
- Illinois Institute of Technology, "Aye-Aye Team"
- University of Illinois at Urbana-Champaign, "University of Illinois"
- Georgia Institute of Technology, "The Georgia Tech Buzzers"
- Colorado School of Mines, "Orediggers"
- Missouri University of Science & Technology, "The Miller Indices"
- University of Tennessee Knoxville, "The VOL-ymer Blends"
- Arizona State University, "Sun Devils"
- University of Michigan, Ann Arbor, "University of Michigan Wolverines"
- North Carolina State University, "NC State"
- Florida International University, "Alchemists 2.0"

Find out which team is the champion in the Monday edition of *TMS News*.



**TMS2019 MOBILE APP**



Build a personalized schedule, view the latest technical program information, access venue maps, and more with the TMS2019 mobile application. To download, search "TMS Annual Meeting" in the App Store or the Google Play™ Store.



The App's features include:

- Latest programming schedule
- Complete abstracts
- Ability to build a personalized schedule
- Speaker information
- Exhibit map
- Exhibitors and sponsors
- Venue information
- Access to *TMS2019 News*

If you need assistance downloading or using the TMS2019 App, please visit the Member Welcome Center.

**TMS2019 NEWS:**

**YOUR DAILY MEETING NEWSLETTER**

Want to stay informed of everything that's happening at the TMS 2019 Annual Meeting & Exhibition? *TMS2019 News*, a daily newsletter reporting on conference activities and events, will be published each morning, Sunday through Thursday, during the conference. You can access the newsletter through the TMS2019 app at any time, through the TMS2019 website, or by clicking on the link in the notification e-mail we'll send each morning.

Each issue will provide a reminder of the big events planned for the day, as well as recaps and photos from events happening around the meeting. So before you start your day at TMS2019, sit down with a cup of coffee and skim *TMS2019 News* so that you don't miss a thing.

**TWEET YOUR OWN UPDATES**

Keep each other updated on meeting activities, interesting talks, and tips on the best local restaurants. Use **#TMSAnnualMeeting** to tweet your observations to **@TMSociety**.

**PLEASE NOTE: LOG IN REQUIRED FOR TMS2019 APP**

The first time you open the TMS2019 App, you will be asked to log in using your TMS2019 registration confirmation number. This number will be in your e-mailed registration confirmation and is conveniently printed on the front of your badge. Please remember to use the hyphen when entering your unique confirmation code (19-xxxxx).

**TMS2019 MOBILE APP DASHBOARD**

The dashboard features the following callouts:

- Schedule:** Get the full TMS2019 schedule including technical sessions/presentations, socials, business meetings, and the exhibition.
- Exhibitors:** View a complete list of exhibiting companies, access the exhibit hall map, and schedule appointments.
- Exhibit Map:** Directly access a map of the exhibit hall.
- My Meeting:** Access saved sessions you want to attend, exhibitors you wish to visit, notes, and more.
- Registrants:** Search the names of other TMS2019 attendees who have chosen to be included on our registrants' contact list and send messages.
- Happening Now:** Expedite your planning by viewing what's going on within the current hour.
- Venue Maps:** Get your bearings with full color maps of the Convention Center and TMS Headquarters Hotel.
- Information:** Find updates and information about special events, Collected Proceedings, and general TMS2019 information.
- Newsletter:** Keep up with the latest TMS2019 news.
- Announcements:** Receive important advisories.
- Around Here:** Need transportation, restaurant options, or the nearest pharmacy? See what's nearby.

## MEMBER SERVICES & INFORMATION

### VISIT THE TMS MEMBER WELCOME CENTER

**Location:** Henry B. González Convention Center, Hall 3 Pre-Function

#### Hours of Operation:

Sunday: 7:00 a.m. to 7:00 p.m.  
Monday: 7:00 a.m. to 6:00 p.m.  
Tuesday: 7:00 a.m. to 5:30 p.m.  
Wednesday: 7:00 a.m. to 5:00 p.m.  
Thursday: 7:00 a.m. to 5:00 p.m.

### LOOKING FOR INFORMATION ON YOUR TECHNICAL SYMPOSIUM OR PRESENTATION?

Visit the TMS Programming Support desk, located in the Hall 4A Pre-Function area of the Henry B. González Convention Center.

## WHAT CAN YOU DO AT THE TMS MEMBER WELCOME CENTER?

### FIND TECHNICAL PROGRAM INFORMATION

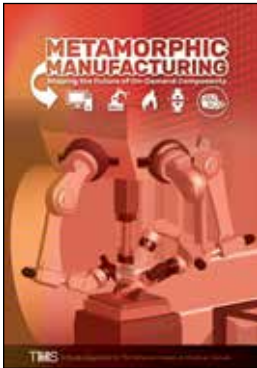
Learn how to access technical program information through the TMS2019 App or pick up a print copy of the TMS2019 technical program.

### PICK UP YOUR 2019 COMMEMORATIVE PIN



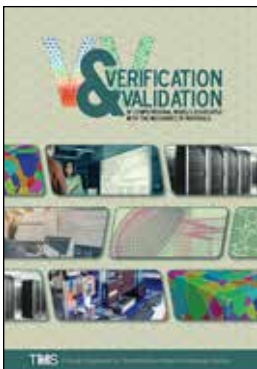
All TMS2019 attendees are invited to pick up their commemorative pin honoring the 70th anniversary of *JOM*, the TMS member journal, which was established in 1949. Bring the ticket attached to your registration badge to the Member Welcome Center to claim your pin.

### PICK UP YOUR FREE COPY OF NEW TMS STUDIES



*Metamorphic Manufacturing: Shaping the Future of On-Demand Components*  
Organized by TMS on behalf of the Office of Naval Research and the Lightweight Innovations for Tomorrow Manufacturing Institute

Download for free at:  
[www.tms.org/MetamorphicManufacturing](http://www.tms.org/MetamorphicManufacturing)



*Verification and Validation of Computational Models Associated with the Mechanics of Materials*  
Organized by TMS on behalf of the National Science Foundation

Download for free at:  
[www.tms.org/VerificationandValidation](http://www.tms.org/VerificationandValidation)

### LEARN ABOUT MATERIALS EXPLORERS™

TMS's *Materials Explorers™* educational outreach initiative offers members the opportunity to share their interest in science and engineering with students. At the TMS Member Welcome Center, you can watch videos, talk to volunteers who have used the program at local schools, and sign up to bring the program to schools in your area.

### VIEW THE TMS FOUNDATION HONOR ROLL

Take a moment to view the TMS Foundation Honor Roll, which thanks all of the individuals and organizations who donated to the TMS Foundation in 2018.

### ASK QUESTIONS

Please visit the TMS Member Welcome Center with any questions you may have about your membership or simply stop by to introduce yourself to TMS staff.

### FIRST-TIME ATTENDEES: PICK UP YOUR WELCOME GIFT

If this is your first time attending a TMS annual meeting, visit the TMS Member Welcome Center to pick up a guide to making the most of your new TMS membership and use the ticket attached to your registration badge to claim a small gift to thank you for joining us at TMS2019.

### REPEAT ATTENDEES: CLAIM YOUR THANK YOU GIFT

If you have attended ten or more consecutive TMS annual meetings, stop by the TMS Member Welcome Center for your gift—our small way of saying thank you for your loyalty to us and our conference. Eligible attendees received an e-mail in advance of the meeting and can use the ticket attached to their name badge to claim their gift.

**MEETING BADGES**

All attendees must wear registration badges at all times during the meeting to ensure admission to events included in the paid registration fee, such as technical sessions, exhibition, and receptions. "Exhibit Only" badges only provide admittance to the show floor for events in the exhibit hall. "Exhibit Only" attendees may not attend technical sessions.

**BADGE REPLACEMENT FEE**

There is a \$25 fee to reprint lost badges. Visit the registration area to request a replacement badge.

**GUEST SESSION ACCESS**

Each full-conference attendee is permitted up to two guests for one session at which they are presenting. This does not include colleagues or exhibitors. This access is intended for family members who wish to listen to one talk presented by their relative. No one under 18 permitted. Please provide the names of the guests who will be attending your presentations when picking up your badge.

**GUEST FUNCTION TICKETS**

You may purchase additional tickets to social functions for your guests at the registration desk.

**REFUND POLICY**

The deadline for all refunds was February 1, 2019. No refunds will be issued at the meeting. Fees and tickets are nonrefundable. TMS is not responsible for "no-show" presenters. Presenters are scheduled and advertised in good faith based on the presenter's proposal to be included in the program.

**PHOTOGRAPHY AND AUDIO/  
VIDEO RECORDING POLICY**

TMS reserves the right to all audio and video reproductions of presentations at TMS-sponsored meetings. By registering for this meeting, all attendees acknowledge that they may be photographed by TMS personnel while at events, and that those photos may be used for promotional purposes, in TMS publications and websites, and on social media sites. **Any recording of sessions (audio, video, still photography, etc.) intended for personal use, distribution, publication, or copyright without the express written consent of TMS and the individual authors is strictly prohibited.** Attendees violating this policy may be asked to leave the session or the meeting without refund.

**ANTI-HARASSMENT POLICY**

TMS policy prohibits conduct that is disrespectful, unprofessional, or harassing as related to any number of factors including, but not limited to, religion, ethnicity, gender, national origin or ancestry, physical or mental disability, physical appearance, medical condition, partner status, age, sexual orientation, military and veteran status, or any other characteristic protected by relevant federal, state, or local law or ordinance or regulation. Failure to comply with this policy could lead to censure from the TMS Board of Directors, potential legal action, or other actions. Anyone who witnesses prohibited conduct should notify a TMS staff member as soon as possible following the incident so that the issue can be addressed in a timely manner.

**TMS DIVERSITY AND INCLUSION STATEMENT**

The Minerals, Metals & Materials Society (TMS) is committed to advancing diversity in the minerals, metals, and materials professions, and to promoting an inclusive professional culture that welcomes and engages all who seek to contribute to the field. TMS recognizes that a diverse minerals, metals, and materials workforce is critical to ensuring that all viewpoints, perspectives, and talents are brought to bear in addressing complex science and engineering challenges. To build and nurture this diverse professional community, TMS welcomes and actively engages the participation of underrepresented groups in all of its initiatives and endeavors.

**ANTITRUST COMPLIANCE POLICY**

TMS complies with the antitrust laws of the United States. Attendees are encouraged to consult with their own corporate counsel for further guidance in complying with U.S. and foreign antitrust laws and regulations.

**AMERICANS WITH DISABILITIES ACT**

TMS strongly supports the federal Americans with Disabilities Act (ADA) which prohibits discrimination against, and promotes public accessibility for, those with disabilities. In support of, and in compliance with ADA, we ask those requiring specific equipment or services to contact TMS Meeting Services in advance at 1-724-776-9000 or on-site at the TMS Member Welcome Center.

**CELL PHONE USE**

In consideration of attendees and presenters, TMS kindly requests that you minimize disturbances by setting all cell phones and other devices on "silent" while in meeting rooms.



## Creation of Nano-Powders with the FRITSCH Planetary Micro Mill PULVERISETTE 7 *premium line*

Revolutionary comminution concept for small samples into the nano-range ( $1\text{nm} = 10^{-9}\text{m}$ ).

Materials science, engineering, & chemistry professionals make use of the Pulverisette 7 *premium line* in their work with mechanical activation, mechano-chemistry, mechanical alloying, catalysts, oxides, and more. Inert milling options along with GTM (Gas and Temperature Measurement) System, and Mill Control Software allows more insight to your process, efficiency, and programmable control of your mill and process- in the right environment.

### Principle of the planetary mills

In a planetary mill, the sample is placed inside a grinding bowl along with the grinding balls. The grinding bowls are fastened to a sun disk where they counter rotate around the center at high speeds creating impact forces, shearing, and grinding of particles inside. The maximum rotational speed of *premium line* is 1100 rpm and therefore there is increase of the kinetic energy of the grinding bodies by 150% over classic planetary ball mills. The grinding duration into the nano scale is drastically reduced. The increased energy makes the comminution of nano particles for certain materials possible.

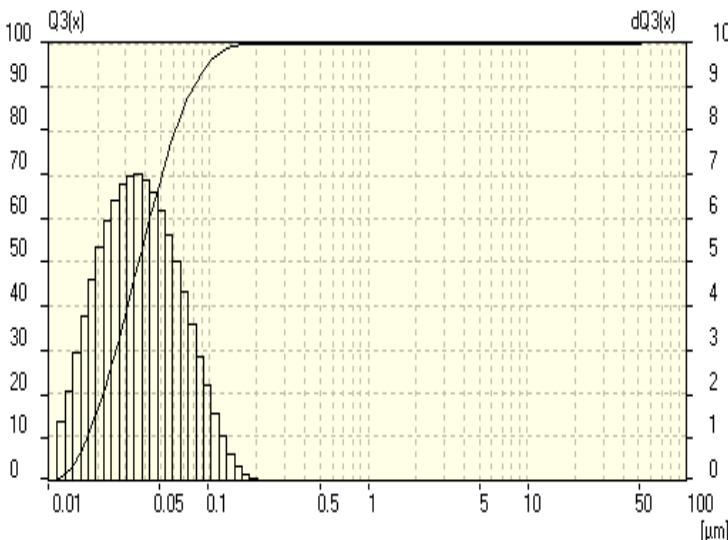
### Nano grinding of aluminium oxide

As a testing system we here present the comminution of aluminium oxide ( $\text{Al}_2\text{O}_3$ ). The  $d_{50}$  value of the base material is  $20\mu\text{m}$ . 5ml  $\text{Al}_2\text{O}_3$  and along with water and 0.5 mm zirconium oxide balls are in 60 minutes ground down to approximately 300 nm. In order to reach the range of  $<100\text{nm}$ , it is necessary to utilize even smaller grinding balls. We use  $\text{ZrO}_2$  balls with a diameter of 0.1mm. After an additional 180 minutes we obtain the following result:



PULVERISETTE 7 *premium line*

d value [%]	grain size [nm]
$d_{10}$	17
$d_{50}$	32
$d_{90}$	80



### Analysis and Method Information

The depicted size distribution was measured using FRITSCH Laser Particle Sizer ANALYSETTE 22, in consideration of the corresponding Mie parameters. With a ball mill comminution, a certain abrasion on the grinding bodies cannot be avoided. This occurring abrasion was in the above measuring deducted from the original.

Comparable results can also be achieved with other, hard fibrous metal oxides. The comminution is in a suspension. Dry comminution is not possible for particle size reduction applications. Nano particles have a very large specific surface. Therefore the suspension is not stable during the end of the comminution, i.e. the particles re-agglomerate very fast. For the stabilization special additives have to be used. Corresponding tests are performed in our application laboratory.



Event/Function	Date	Start Time	End Time	Venue	Room	Access
<b>Saturday, March 9</b>						
<b>Committee &amp; Business Meetings</b>						
Professional Registration Item Writers Workshop and Committee Meeting	9-Mar	9:00 AM	5:00 PM	Hyatt	Travis CD	R
Professional Registration Committee Dinner	9-Mar	6:00 PM	8:00 PM	Little Rhein Steak House	TBD	R
<b>Sunday, March 10</b>						
<b>All-Conference Events</b>						
Registration	10-Mar	7:00 AM	7:00 PM	HBGCC	Hall 3 Pre-Function	O
TMS Member Welcome Center	10-Mar	7:00 AM	7:00 PM	HBGCC	Hall 3 Pre-Function	O
Programming Support Desk	10-Mar	2:00 PM	6:00 PM	HBGCC	Hall 4A Pre-Function	O
President's Welcoming Reception	10-Mar	6:00 PM	7:00 PM	HBGCC	Hall 4A	O
<b>Exhibition</b>						
Exhibit Move In	10-Mar	8:00 AM	5:00 PM	HBGCC	Hall 3	R
Bladesmithing Competition Check-In	10-Mar	12:00 PM	5:00 PM	HBGCC	Hall 3	I
<b>Professional Development &amp; Special Lectures</b>						
Additive Manufacturing Materials and Processes	10-Mar	8:00 AM	12:30 PM	HBGCC	225D	T
Powder Handling for Safety and Quality	10-Mar	8:00 AM	12:00 PM	HBGCC	225C	T
Atom-Probe Tomography: A Primer	10-Mar	8:00 AM	5:30 PM	HBGCC	224	T
Additive Manufacturing Standards, Qualification, and Certification Workshop	10-Mar	1:30 PM	5:30 PM	HBGCC	225D	T
<b>Student &amp; Young Professional Functions</b>						
Materials Bowl	10-Mar	2:00 PM	6:00 PM	HBGCC	Lila Cockrell Theatre	O
<i>Elimination Rounds</i>	10-Mar	2:00 PM	5:00 PM	HBGCC	Lila Cockrell Theatre	O
<i>Championship Round</i>	10-Mar	5:00 PM	6:00 PM	HBGCC	Lila Cockrell Theatre	O
Student Networking Mixer	10-Mar	7:00 PM	8:30 PM	Hyatt	Lonestar Ballroom BC	O
<b>Social Functions</b>						
TMS Fellows and Invited Guests Reception	10-Mar	4:30 PM	6:30 PM	Hyatt	Crockett AB	I
TMS LGBTQ+ and Allies Mixer	10-Mar	8:00 PM	11:00 PM	Hyatt	Lonestar Ballroom A	O
<b>Committee &amp; Business Meetings</b>						
New Board Member Orientation	10-Mar	7:30 AM	9:00 AM	Hyatt	San Jacinto	I
TMS Board of Directors Meeting	10-Mar	10:00 AM	1:00 PM	Hyatt	Bowie ABC	I
Accreditation Committee	10-Mar	12:30 PM	2:30 PM	Hyatt	Travis AB	O
Technical Division Chairs Meeting	10-Mar	1:30 PM	2:30 PM	Hyatt	Goliad	I

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required



# CALENDAR OF EVENTS

as of February 7, 2019

Event/Function	Date	Start Time	End Time	Venue	Room	Access
Magnesium Committee Meeting	10-Mar	1:30 PM	3:00 PM	HBGCC	221B	O
TMS Nominating Committee Meeting	10-Mar	1:30 PM	3:00 PM	Hyatt	San Jacinto	R
Recycling and Environmental Technologies Committee Meeting	10-Mar	1:30 PM	3:00 PM	Hyatt	Mission A	O
<i>Metallurgical and Materials Transactions</i> Board of Review	10-Mar	2:00 PM	3:00 PM	Hyatt	Travis CD	I
Aluminum Committee Meeting	10-Mar	2:00 PM	4:00 PM	Hyatt	Lonestar Ballroom A	O
Materials Characterization Committee Meeting	10-Mar	2:30 PM	4:00 PM	Hyatt	Bowie ABC	O
Pyrometallurgy Committee Meeting	10-Mar	3:00 PM	4:30 PM	Hyatt	Travis AB	O
Public & Governmental Affairs Committee	10-Mar	3:30 PM	5:30 PM	Hyatt	Mission B	R
Hydrometallurgy and Electrometallurgy Committee Meeting	10-Mar	4:00 PM	5:00 PM	Hyatt	Mission A	O
TMS Program Committee Meeting	10-Mar	4:00 PM	6:00 PM	Hyatt	Bowie ABC	I
JOM Advisor Briefing	10-Mar	4:30 PM	5:30 PM	Hyatt	Travis CD	I
Diversity Committee Meeting	10-Mar	4:30 PM	6:00 PM	Hyatt	Lonestar Ballroom A	O
Process Technology and Modeling Committee Meeting	10-Mar	5:00 PM	6:00 PM	Hyatt	Mission A	O
Thin Films and Interfaces Committee Meeting	10-Mar	5:00 PM	6:00 PM	Hyatt	Bonham B	O
<i>Integrating Materials and Manufacturing Innovation</i> Editorial Board	10-Mar	5:00 PM	6:00 PM	Hyatt	Goliad	I
Additive Manufacturing Committee Meeting	10-Mar	5:30 PM	7:00 PM	HBGCC	221A	O
Aluminum Course Organizers	10-Mar	6:00 PM	7:00 PM	Hyatt	San Jacinto	I
Nanomechanical Materials Behavior Committee Meeting	10-Mar	6:00 PM	7:30 PM	HBGCC	221B	O
Mechanical Behavior of Materials Committee Meeting	10-Mar	7:30 PM	9:00 PM	HBGCC	221B	O
Phase Transformations Committee Meeting	10-Mar	7:30 PM	9:00 PM	Hyatt	Bonham B	O

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required

## ANNOUNCING THE 2019 TMS MEETING OF THE MEMBERSHIP AND OPEN BOARD OF DIRECTORS MEETING

The Minerals, Metals & Materials Society, Inc. (TMS), in accordance with its bylaws (Article II, Section 2.6, and Article III, Section 3.7) will hold its 2019 Annual Meeting of the Membership with an open Board of Directors Meeting, on Thursday, March 14, 2019, from 8:00 a.m. to 8:30 a.m. (CT) in the Mission B Room at the Grand Hyatt San Antonio during the TMS 2019 Annual Meeting & Exhibition. All TMS members are welcome to attend this meeting.

Event/Function	Date	Start Time	End Time	Venue	Room	Access
<b>Monday, March 11</b>						
<b>All-Conference Events</b>						
Presenters' Coffee	11-Mar	6:45 AM	7:45 AM	HBGCC	Hall 4A	O
Registration	11-Mar	7:00 AM	6:00 PM	HBGCC	Hall 3 Pre-Function	O
TMS Member Welcome Center	11-Mar	7:00 AM	6:00 PM	HBGCC	Hall 3 Pre-Function	O
Programming Support Desk	11-Mar	7:00 AM	6:00 PM	HBGCC	Hall 4A Pre-Function	O
Technical Programming Sessions	11-Mar	8:00 AM	6:00 PM	HBGCC	<i>See Technical Program for complete schedule and locations</i>	O
Morning Break	11-Mar	9:20 AM	10:00 AM	HBGCC	Various	O
All-Conference Plenary Session	11-Mar	12:00 PM	1:00 PM	HBGCC	Lila Cockrell Theatre	O
Afternoon Break	11-Mar	3:50 PM	4:30 PM	HBGCC	Various	O
<b>Exhibition</b>						
Exhibit Move In	11-Mar	8:00 AM	10:00 AM	HBGCC	Hall 3	R
TMS2019 Exhibition	11-Mar	11:00 AM	7:00 PM	HBGCC	Hall 3	O
2019 TMS Bladesmithing Competition Display	11-Mar	11:00 AM	7:00 PM	HBGCC	Hall 3	O
Poster Session I Poster Installation	11-Mar	12:00 PM	2:00 PM	HBGCC	Hall 3	O
Lunch in the Exhibit Hall	11-Mar	1:00 PM	2:30 PM	HBGCC	Hall 3	T
Poster Session I Gallery Viewing	11-Mar	2:00 PM	5:30 PM	HBGCC	Hall 3	O
Exhibit Opening Reception & Poster Session I Presentations	11-Mar	5:30 PM	7:00 PM	HBGCC	Hall 3	O
Poster Session I Dismantle	11-Mar	7:00 PM	7:00 PM	HBGCC	Hall 3	O
<b>Student &amp; Young Professional Functions</b>						
Meet-a-Mentor Reception	11-Mar	5:00 PM	6:30 PM	Hyatt	Lonestar Ballroom B	I
Technical Division Student Poster Contest	11-Mar	5:30 PM	7:00 PM	HBGCC	Hall 3	O
<b>Social Functions</b>						
SMD Luncheon	11-Mar	1:00 PM	2:30 PM	Hyatt	Lonestar Ballroom A	T
University of Florida Alumni & Friends Social	11-Mar	7:00 PM	9:00 PM	Hyatt	Lonestar Ballroom C	O
University of Tennessee Alumni & Friends Social	11-Mar	7:00 PM	9:00 PM	Hyatt	Mission A	O
<b>Committee &amp; Business Meetings</b>						
Membership & Student Development Committee Meeting	11-Mar	7:30 AM	9:30 AM	Hyatt	Travis CD	R
TMS Executive Committee Meeting	11-Mar	9:00 AM	11:00 AM	Hyatt	San Jacinto	I
EPD Council Meeting	11-Mar	1:00 PM	3:00 PM	Hyatt	Bowie ABC	I
Powder Materials Committee Meeting	11-Mar	1:15 PM	2:30 PM	Hyatt	Travis CD	O
Integrated Computational Materials Engineering Committee Meeting	11-Mar	1:15 PM	2:30 PM	HBGCC	305	O

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required

# CALENDAR OF EVENTS

as of February 7, 2019

Event/Function	Date	Start Time	End Time	Venue	Room	Access
Superalloys 2020 Organizing Committee Meeting	11-Mar	5:30 PM	7:00 PM	Hyatt	Bonham B	I
Steels Committee Meeting	11-Mar	6:00 PM	7:00 PM	Hyatt	Travis CD	O
Refractory Metals & Materials Committee Meeting	11-Mar	6:00 PM	7:00 PM	HBGCC	205	O
Biomaterials Committee Meeting	11-Mar	6:00 PM	7:00 PM	HBGCC	217A	O
Chemistry and Physics of Materials Committee Meeting	11-Mar	6:00 PM	7:00 PM	HBGCC	303C	O
Advanced Characterization, Testing and Simulation Committee Meeting	11-Mar	6:00 PM	7:00 PM	HBGCC	302A	O
Surface Engineering Committee Meeting	11-Mar	6:00 PM	7:00 PM	HBGCC	210A	O
Materials Innovation Committee	11-Mar	6:00 PM	7:30 PM	Hyatt	Travis AB	R
Nuclear Materials Committee Meeting	11-Mar	6:00 PM	7:30 PM	HBGCC	215	O
Shaping and Forming Committee Meeting	11-Mar	6:00 PM	7:30 PM	HBGCC	006B	O
Composite Materials Committee Meeting	11-Mar	6:30 PM	7:30 PM	HBGCC	303B	O
LMD Council Meeting	11-Mar	6:30 PM	8:30 PM	Hyatt	Bowie ABC	I
Alloy Phases Committee Meeting	11-Mar	7:00 PM	8:30 PM	HBGCC	006D	O
Computational Materials Science & Engineering Committee Meeting	11-Mar	7:30 PM	8:30 PM	HBGCC	304C	O

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required

## YOU ARE INVITED TO ATTEND A TECHNICAL COMMITTEE MEETING

Attend one of our open technical committee meetings this week to meet colleagues with similar interests and to become a contributing member of the TMS community. View a complete listing of technical committee meetings on page 26 for meeting times and locations.



## PICK UP YOUR COMMEMORATIVE PIN

Established in 1949 as the flagship member journal of TMS, *JOM* embodies the Society's commitment to excellence in its technical publications. As with all aspects of TMS, volunteers serve as the driving force behind the journal by contributing to its development, content, and strategic direction. As a gift of appreciation, all TMS2019 attendees are invited to pick up their commemorative pin honoring the 70th anniversary of *JOM* at the TMS Member Welcome Center. Find the ticket for your pin attached to your registration badge.

Event/Function	Date	Start Time	End Time	Venue	Room	Access
<b>Tuesday, March 12</b>						
<b>All-Conference Events</b>						
Presenters' Coffee	12-Mar	7:00 AM	8:00 AM	HBGCC	Hall 4A	O
Registration	12-Mar	7:00 AM	5:30 PM	HBGCC	Hall 3 Pre-Function	O
TMS Member Welcome Center	12-Mar	7:00 AM	5:30 PM	HBGCC	Hall 3 Pre-Function	O
Programming Support Desk	12-Mar	7:00 AM	6:00 PM	HBGCC	Hall 4A Pre-Function	O
Technical Programming Sessions	12-Mar	8:30 AM	5:30 PM	HBGCC	<i>See Technical Program for complete schedule and locations</i>	O
Morning Break	12-Mar	9:50 AM	10:30 AM	HBGCC	Various	O
Afternoon Break	12-Mar	3:20 PM	4:00 PM	HBGCC	Various	O
Bladesmithing Competition: Awards Presentation	12-Mar	5:00 PM	5:30 PM	HBGCC	Lila Cockrell Theatre	O
<b>Exhibition</b>						
TMS2019 Exhibition	12-Mar	11:00 AM	7:00 PM	HBGCC	Hall 3	O
2019 TMS Bladesmithing Competition Display	12-Mar	11:00 AM	7:00 PM	HBGCC	Hall 3	O
Lunch in the Exhibit Hall	12-Mar	11:30 AM	1:30 PM	HBGCC	Hall 3	T
Poster Session II Poster Installation	12-Mar	12:00 PM	2:00 PM	HBGCC	Hall 3	O
Poster Session II Gallery Viewing	12-Mar	2:00 PM	5:30 PM	HBGCC	Hall 3	O
Exhibit Hall Happy Hour & Poster Session II Presentations	12-Mar	5:30 PM	7:00 PM	HBGCC	Hall 3	O
REWAS 2019 Reception	12-Mar	5:30 PM	7:00 PM	HBGCC	Hall 3	O
Poster Session II Dismantle	12-Mar	7:00 PM	7:00 PM	HBGCC	Hall 3	O
<b>Student &amp; Young Professional Functions</b>						
Young Professional Tutorial Luncheon	12-Mar	12:00 PM	12:45 PM	Hyatt	Lonestar Ballroom C	T
Young Professional Tutorial Lecture	12-Mar	12:45 PM	2:00 PM	Hyatt	Lonestar Ballroom C	O
Student Career Forum	12-Mar	2:00 PM	4:00 PM	Hyatt	Lonestar Ballroom B	O
<b>Social Functions</b>						
EPD/MPMD Luncheon	12-Mar	12:00 PM	2:00 PM	Hyatt	Lonestar Ballroom A	T
<b>Committee &amp; Business Meetings</b>						
Mobile App Focus Group	12-Mar	7:15 AM	8:30 AM	Hyatt	Mission A	I
Energy Conversion and Storage Committee Meeting	12-Mar	7:30 AM	8:30 AM	HBGCC	225A	O
Fellows Award Subcommittee Meeting	12-Mar	7:30 AM	8:30 AM	Hyatt	San Jacinto	R
TMS Foundation Board of Trustees Meeting	12-Mar	7:30 AM	10:00 AM	Hyatt	Bonham B	I
Young Professionals Committee Meeting	12-Mar	8:00 AM	9:30 AM	Hyatt	Bowie ABC	O
Honors & Professional Recognition Committee Meeting	12-Mar	8:30 AM	9:30 AM	Hyatt	San Jacinto	R

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required

# CALENDAR OF EVENTS

as of February 7, 2019

Event/Function	Date	Start Time	End Time	Venue	Room	Access
Professional Development Committee Meeting	12-Mar	10:00 AM	12:00 PM	Hyatt	Travis AB	I
TMS Industrial Advisory Committee	12-Mar	10:00 AM	2:00 PM	Hyatt	Mission B	I
TMS Past Presidents Meeting	12-Mar	11:30 AM	1:00 PM	HBGCC	220	I
SMD Council Meeting	12-Mar	12:00 PM	2:00 PM	Hyatt	Bowie ABC	I
Electronic Packaging and Interconnection Materials Committee Meeting	12-Mar	12:30 PM	1:30 PM	HBGCC	216A	O
Education Committee	12-Mar	12:30 PM	2:30 PM	Hyatt	Travis AB	R
2021 TMS-AIME Anniversary Ad Hoc Committee	12-Mar	1:30 PM	3:30 PM	Hyatt	San Jacinto	I
Leadership Recruitment Committee Meeting	12-Mar	3:00 PM	4:00 PM	Hyatt	Goliad	R
Preparing A Winning Application Package Workshop	12-Mar	4:00 PM	6:00 PM	Hyatt	Mission A	O
Content Development and Dissemination Committee Meeting	12-Mar	5:00 PM	7:00 PM	Hyatt	Travis CD	I
Solidification Committee Meeting	12-Mar	5:45 PM	6:45 PM	HBGCC	006C	O
Corrosion and Environmental Effects Committee Meeting	12-Mar	6:00 PM	7:00 PM	HBGCC	224	O
Energy Committee Meeting	12-Mar	6:00 PM	7:00 PM	HBGCC	225A	O
Nanomaterials Committee Meeting	12-Mar	6:00 PM	7:00 PM	HBGCC	211	O
Titanium Committee Meeting	12-Mar	6:00 PM	7:00 PM	HBGCC	006A	O
High Temperature Alloys Committee Meeting	12-Mar	6:00 PM	7:30 PM	Hyatt	Travis AB	O
MPMD Council Meeting	12-Mar	6:30 PM	8:30 PM	Hyatt	Bowie ABC	I
Magnetic Materials Committee Meeting	12-Mar	7:00 PM	8:00 PM	HBGCC	225B	O

## Wednesday, March 13

### All-Conference Events

Presenters' Coffee	13-Mar	7:00 AM	8:00 AM	HBGCC	Hall 4A	O
Registration	13-Mar	7:00 AM	5:00 PM	HBGCC	Hall 3 Pre-Function	O
TMS Member Welcome Center	13-Mar	7:00 AM	5:00 PM	HBGCC	Hall 3 Pre-Function	O
Programming Support Desk	13-Mar	7:00 AM	6:00 PM	HBGCC	Hall 4A Pre-Function	O
Technical Programming Sessions	13-Mar	8:30 AM	5:30 PM	HBGCC	<i>See Technical Program for complete schedule and locations</i>	O
Morning Break	13-Mar	9:50 AM	10:30 AM	HBGCC	Various	O
Afternoon Break	13-Mar	3:20 PM	4:00 PM	HBGCC	Various	O

### Exhibition

TMS2019 Exhibition	13-Mar	10:00 AM	2:00 PM	HBGCC	Hall 3	O
2019 TMS Bladesmithing Competition Display	13-Mar	10:00 AM	2:00 PM	HBGCC	Hall 3	O
Lunch in the Exhibit Hall	13-Mar	11:30 AM	1:30 PM	HBGCC	Hall 3	T
Bladesmithing Competition: Mandatory Blade Check Out	13-Mar	2:00 PM	4:00 PM	HBGCC	Hall 3	R

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required



Event/Function	Date	Start Time	End Time	Venue	Room	Access
Exhibitor Move-out	13-Mar	2:00 PM	7:00 PM	HBGCC	Hall 3	R
<b>Social Functions</b>						
Fresh Coffee, Fresh Ideas: Diversity and Inclusion Breakfast	13-Mar	7:00 AM	8:00 AM	Hyatt	Lonestar Ballroom A	T
LMD Luncheon	13-Mar	12:00 PM	2:00 PM	Hyatt	Lonestar Ballroom A	T
<i>Metamorphic Manufacturing: Shaping the Future of On-Demand Components</i> An Information Session with the Experts	13-Mar	12:30 PM	1:30 PM	HBGCC	220	O
JOM Advisor Mixer	13-Mar	4:30 PM	6:00 PM	Hyatt	Mission A	I
TMS-AIME Awards Reception	13-Mar	5:30 PM	6:00 PM	HBGCC	Lila Cockrell Theatre Pre-Function	O
TMS-AIME Awards Ceremony	13-Mar	6:00 PM	7:30 PM	HBGCC	Lila Cockrell Theatre	O
TMS-AIME Awards Banquet	13-Mar	7:30 PM	8:30 PM	Hyatt	Lonestar Ballroom ABC	T
Awards Afterglow Reception	13-Mar	8:30 PM	10:00 PM	Hyatt	Lonestar Ballroom ABC Pre-Function	T
<b>Committee &amp; Business Meetings</b>						
REWAS Organizing Committee Meeting	13-Mar	7:00 AM	8:00 AM	Hyatt	Presidio AB	I
Light Metals 2020 Subject Chairs	13-Mar	7:00 AM	8:30 AM	Hyatt	San Jacinto	I
Financial Planning Committee Meeting	13-Mar	8:00 AM	10:30 AM	Hyatt	Goliad	R
FMD Council Meeting	13-Mar	12:00 PM	2:00 PM	Hyatt	Bowie ABC	I
Extraction 20XX Planning Meeting	13-Mar	12:00 PM	2:00 PM	Hyatt	Mission A	I
International Affairs Committee Meeting	13-Mar	2:00 PM	3:30 PM	Hyatt	San Jacinto	I
TMS2020 Programming Information Session	13-Mar	5:00 PM	6:00 PM	Hyatt	Travis AB	I
<b>Thursday, March 14</b>						
<b>All-Conference Events</b>						
Presenters' Coffee	14-Mar	7:00 AM	8:00 AM	HBGCC	Hall 4A	O
Registration	14-Mar	7:00 AM	2:00 PM	HBGCC	Hall 3 Pre-Function	O
TMS Member Welcome Center	14-Mar	7:00 AM	5:00 PM	HBGCC	Hall 3 Pre-Function	O
Programming Support Desk	14-Mar	7:00 AM	6:00 PM	HBGCC	Hall 4A Pre-Function	O
Technical Programming Sessions	14-Mar	8:30 AM	5:30 PM	HBGCC	<i>See Technical Program for complete schedule and locations</i>	O
Morning Break	14-Mar	9:50 AM	10:30 AM	HBGCC	Various	O
Afternoon Break	14-Mar	3:20 PM	4:00 PM	HBGCC	Various	O
<b>Committee &amp; Business Meetings</b>						
The Annual Meeting of the Membership and Open Board Meeting	14-Mar	8:00 AM	8:30 AM	Hyatt	Mission B	O
TMS Board of Directors Meeting	14-Mar	8:30 AM	1:00 PM	Hyatt	Bowie ABC	I

**HBGCC** = Henry B. González Convention Center; **Hyatt** = Grand Hyatt San Antonio

**O** = Open to All Attendees **R** = Restrictions Apply **I** = Invitation Only **T** = Ticketed Event, Pre-registration required

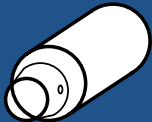
## TECHNICAL COMMITTEE SCHEDULE

	Time	Room
<b>Sunday, March 10, 2019</b>		
Magnesium	1:30 p.m. to 3:00 p.m.	HBGCC - Room 221B
Recycling & Environmental Technologies	1:30 p.m. to 3:00 p.m.	GHH - Mission A
Aluminum	2:00 p.m. to 4:00 p.m.	GHH - Lonestar Ballroom A
Materials Characterization	2:30 p.m. to 4:00 p.m.	GHH - Bowie ABC
Pyrometallurgy	3:00 p.m. to 4:30 p.m.	GHH - Travis AB
Hydrometallurgy & Electrometallurgy	4:00 p.m. to 5:00 p.m.	GHH - Mission A
Process Technology & Modeling	5:00 p.m. to 6:00 p.m.	GHH - Mission A
Thin Films & Interfaces	5:00 p.m. to 6:00 p.m.	GHH - Bonham B
Additive Manufacturing	5:30 p.m. to 7:00 p.m.	HBGCC - Room 221A
Nanomechanical Materials Behavior	6:00 p.m. to 7:30 p.m.	HBGCC - Room 221B
Mechanical Behavior of Materials	7:30 p.m. to 9:00 p.m.	HBGCC - Room 221B
Phase Transformations	7:30 p.m. to 9:00 p.m.	GHH - Bonham B
<b>Monday, March 11, 2019</b>		
Integrated Computational Materials Engineering	1:15 p.m. to 2:30 p.m.	HBGCC - Room 305
Powder Materials	1:15 p.m. to 2:30 p.m.	GHH - Travis CD
Advanced Characterization, Testing & Simulation	6:00 p.m. to 7:00 p.m.	HBGCC - Room 302A
Biomaterials	6:00 p.m. to 7:00 p.m.	HBGCC - Room 217A
Chemistry & Physics of Materials	6:00 p.m. to 7:00 p.m.	HBGCC - Room 303C
Refractory Metals & Materials	6:00 p.m. to 7:00 p.m.	HBGCC - Room 205
Steels	6:00 p.m. to 7:00 p.m.	GHH - Travis CD
Surface Engineering	6:00 p.m. to 7:00 p.m.	HBGCC - Room 210A
Nuclear Materials	6:00 p.m. to 7:30 p.m.	HBGCC - Room 215
Shaping & Forming	6:00 p.m. to 7:30 p.m.	HBGCC - Room 006B
Composite Materials	6:30 p.m. to 7:30 p.m.	HBGCC - Room 303B
Alloy Phases	7:00 p.m. to 8:30 p.m.	HBGCC - Room 006D
Computational Materials Science & Engineering	7:30 p.m. to 8:30 p.m.	HBGCC - Room 304C
<b>Tuesday, March 12, 2019</b>		
Energy Conversion & Storage	7:30 a.m. to 8:30 a.m.	HBGCC - Room 225A
Electronic Packaging & Interconnection Materials	12:30 p.m. to 1:30 p.m.	HBGCC - Room 216A
Solidification	5:45 p.m. to 6:45 p.m.	HBGCC - Room 006C
Corrosion & Environmental Effects	6:00 p.m. to 7:00 p.m.	HBGCC - Room 224
Energy	6:00 p.m. to 7:00 p.m.	HBGCC - Room 225A
Nanomaterials	6:00 p.m. to 7:00 p.m.	HBGCC - Room 211
Titanium	6:00 p.m. to 7:00 p.m.	HBGCC - Room 006A
High Temperature Alloys	6:00 p.m. to 7:30 p.m.	GHH - Travis AB
Magnetic Materials	7:00 p.m. to 8:00 p.m.	HBGCC - Room 225B

Room Key: GHH = Grand Hyatt San Antonio; HBGCC = Henry B. González Convention Center

# EPM

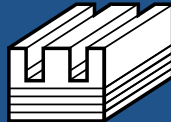
## THE LEADING RUSSIAN MANUFACTURER OF GRAPHITE AND CARBON-BASED PRODUCTS



GRAPHITE  
ELECTRODES



CARBON  
ELECTRODES



CATHODE  
BLOCKS



ELECTRODE  
PASTE



RAMMING  
PASTE

### NOVOCHERKASSK ELECTRODE PLANT

- Started: 1954
- Capacity: 50,000 tonnes of graphite electrodes per annum
- Graphite electrodes



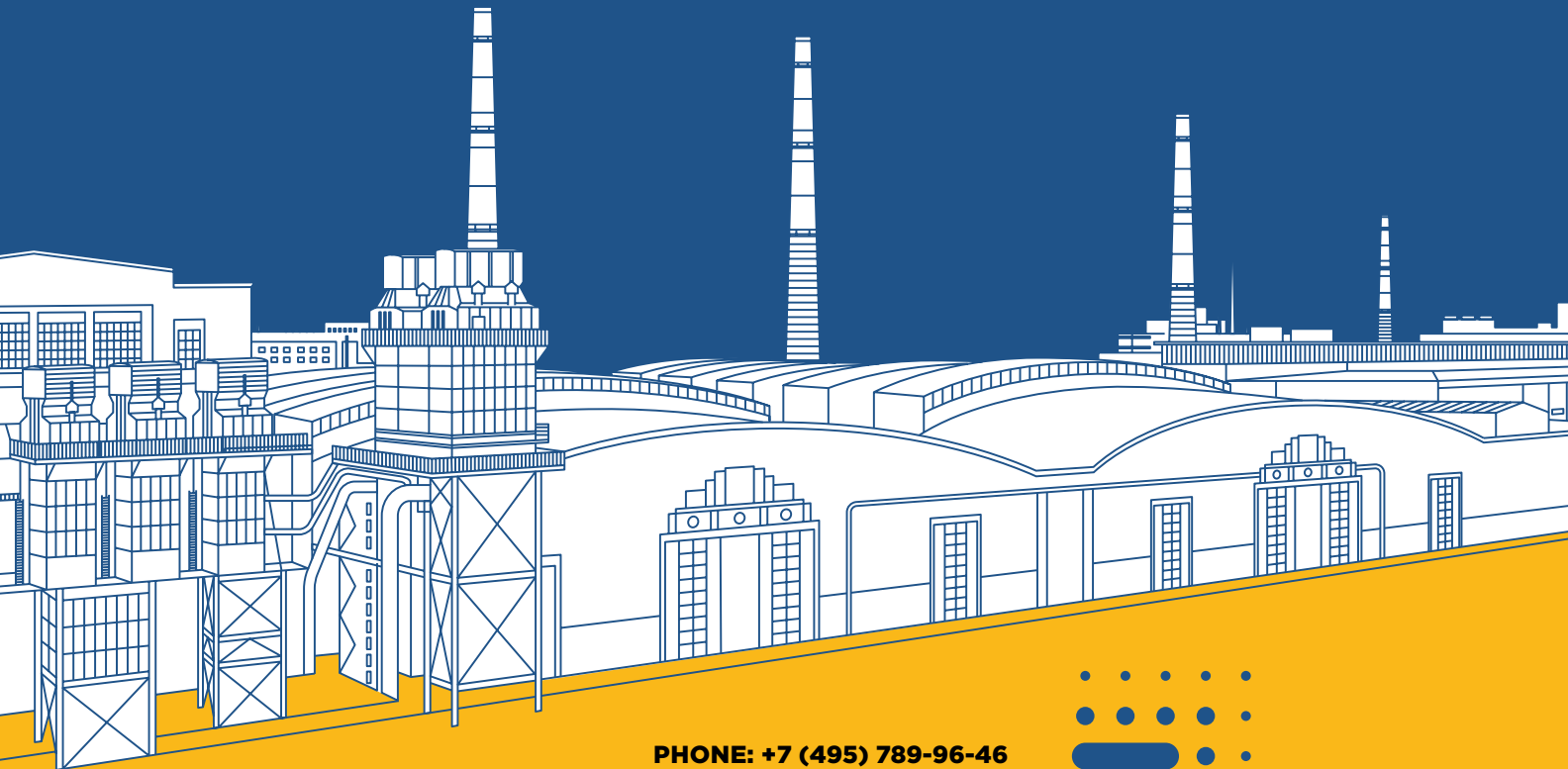
### NOVOSIBIRSK ELECTRODE PLANT

- Started: 1974
- Capacity: 130,000 tonnes per annum
- Carbon electrodes, graphite electrodes, cathode blocks, ramming paste, electrode paste and furnace linings



### DONCARB GRAPHITE

- Started: 2008
- Specialty carbon graphite products, specialty shapes and heat exchanger equipment



PHONE: +7 (495) 789-96-46  
E-MAIL: [ENERGOPROM@ENERGOPROM.RU](mailto:ENERGOPROM@ENERGOPROM.RU)  
ADDRESS: 115035, MOSCOW, KOSMODAMIANSKAYA  
EMBANKMENT, HOUSE 52, BUILDING 5, FLOOR 5



## "The Next Materials Frontier for Flight"

**Date:** Monday, March 11

**Time:** Noon to 1:00 p.m.

**Location:** Henry B. González Convention Center, Lila Cockrell Theater

The drive for more fuel-efficient, longer range and durable aircraft engines has fueled remarkable progress in materials capability since the beginning of human flight. The TMS 2019 Annual Meeting & Exhibition all-conference plenary session will explore this new phase of materials innovation inspired by both manufacturing and digital technology advances.

### ABOUT THE PRESENTATION

While Integrated Computational Materials Engineering (ICME) tools are essential for developing more capable material systems, an expanded set of digital tools is playing an increasingly critical role in scaling and industrializing materials. Iorio will discuss how these digital tools offer a new opportunity to escape from the so-called "Valley of Death" of intermediate technology readiness levels by providing insights into key process variables that affect product quality and performance. These same digital capabilities allow for the rapid development of new material systems, tailored to take advantage of the wide-range of processing conditions that can be achieved via additive manufacturing. In addition, analytics, artificial intelligence, and machine learning tools help to rapidly screen options and optimize the many degrees of freedom available in an additive process.

Advances in materials capability will continue to shape the future of flight in the years to come. Iorio's talk will provide highlights of these new advances at GE, including the introduction of silicon carbide-silicon carbide ceramic-matrix composites and the scaling of additive manufacturing across the engine cross section.



### FEATURED SPEAKER:

**Luana E. Iorio**

General Manager,  
Engineering Material Systems  
GE Aviation

### ABOUT THE PRESENTER

Luana Iorio is General Manager, Engineering Material Systems, GE Aviation, where her team has responsibility for the entire life cycle of the materials used in the 60,000+ GE turbine engines that power both commercial and military aircraft. In fulfilling this role, her team develops novel material systems and processing techniques, spanning a range of materials including superalloys, ceramic and polymer matrix composites, and coatings; provides application engineering and material behavior assessments; and develops and applies component life management methods.

Iorio started her career as a materials scientist at GE Global Research in Niskayuna, New York, and had the opportunity to work on a wide range of materials systems and processes. Prior to assuming her current role, she was the Materials Leader for the then newly created GE Additive business.

Iorio received a B.Sc. in Metallurgical Engineering from the University of the Witwatersrand, South Africa, and M.S. and Ph.D. degrees in Materials Science and Engineering from Carnegie Mellon University.

## GET UP CLOSE WITH THE TECHNOLOGY

Stop by and browse the display of GE Additive technologies related to Iorio's talk, including an additively produced aircraft engine. The display is located outside of the entrance to the TMS2019 Exhibit Hall.

Explore additional industry innovations inside the Exhibit Hall during TMS2019 Exhibition hours.

# NETZSCH

Proven Excellence.

The physical and chemical properties of any material change under the influence of temperature. Such changes can be systematically analyzed by applying specified variations in temperature, atmosphere and pressure.

Since 1962, **NETZSCH** has consistently provided our customers with the latest thermal analysis techniques, the broadest range of highest-quality products, the most complete technical support and the most comprehensive service.

Our instruments and methods allow for material characterization as well as for the study of properties such as specific heat, enthalpy, weight change, Young's modulus, thermal expansion, conductivity, thermal diffusivity, and evolved gas analysis.

**Visit us at Booth 401**

**Ask about our Trade In program**

<https://www.netzsch-thermal-analysis.com/us/>

**TRADE IN &  
TRADE UP**



**TIME  
FOR A  
CHANGE**







## Manufacturing the Circular Materials Economy

TMS2019 welcomes the 6th installment of the REWAS conference series, which will focus on Manufacturing the Circular Materials Economy. This unique, transdisciplinary conference will feature a plenary session of invited speakers, a special roundtable discussion, and the following five technical symposia:

- Disruptive Material Manufacturing: Scaling and Systems Challenges
- Secondary and Byproduct Sources of Materials, Minerals, and Metals
- Rethinking Production
- Cast Shop Recycling Technologies
- Education and Workforce Development

REWAS 2019 is sponsored by the TMS Extraction & Processing Division, the TMS Light Metals Division, and the TMS Recycling & Environmental Technologies Committee.

### REWAS 2019 Reception

**Date:** Tuesday, March 12  
**Time:** 5:30 p.m. to 7:00 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

All TMS 2019 attendees are welcome to join us in the Exhibit Hall to view REWAS 2019 posters and network with REWAS participants.

### REWAS 2019 Plenary Session

**Date:** Tuesday, March 12  
**Time:** 8:30 a.m. to 12:20 p.m.  
**Location:** Henry B. González Convention Center, Room 007C

### PLENARY SPEAKERS:



“Recycling of Critical Metals”  
**Toru Okabe,**  
 University of Tokyo



“Supply Chains for Battery Materials”  
**Ben Jones,**  
 CRU International Limited



“Implications of an Evolving Electronic Waste Stream”  
**Callie Babbitt,**  
 Rochester Institute of Technology



“Is Sustainability Less Than the Sum of Its Parts?”  
**David Waggoner,**  
 Institute of Scrap Recycling Industries, Inc.



“Mineral Exploration of the Urban Mine: Dynamics of Aluminum Stocks and Flows”  
**Chris Bayliss,**  
 International Aluminum Institute



“A New Thinking in Metals Recycling”  
**Ramana Reddy,**  
 The University of Alabama



“Challenges of the Circular Economy”  
**Markus Reuter,**  
 Helmholtz-Institute Freiberg for Resource Technology

**International Round Table on Materials Criticality**

**Date:** Thursday, March 14

**Location:** Henry B. González Convention Center, Room 007C

This year, the REWAS 2019 symposium will host the International Round Table on Materials Criticality (IRTC), one of a series of events being held at established international conferences around the world. The goal of the roundtable is to gather input that will ultimately result in a Roadmap on Criticality, providing advice for authorities and policy makers world-wide. The topic will be "How Does Industry Manage Criticality in Product Development?"

**FEATURED SPEAKERS:**

- **Roderick Eggert**,  
Colorado School of Mines and  
the Critical Materials Institute, USA
- **James Goddin**,  
Granta Design Ltd., United Kingdom
- **Atsufumi Hirohata**,  
University of York, United Kingdom
- **Christina Meskers**,  
Umicore, Belgium
- **David Jarvis**,  
HIPTec AS, Norway
- **Nikolaos Michailidis**,  
Aristotle University of Thessaloniki, Greece
- **Min-Ha Lee**,  
Korea Institute of Industrial Technology,  
South Korea
- **Armin Reller**,  
ESM Foundation, Switzerland
- **Steven Young**,  
University of Waterloo, Canada

**IRTC Sponsors:**

**Sponsored by:** ESM Foundation



**Co-sponsored by:** The Federation of European Materials Societies (FEMS).



**REWAS 2019 Organizers**

- Gabrielle Gaustad**,  
Alfred University
- Camille Fleuriault**,  
Gopher Resource
- Mertol Gökelma**,  
Norwegian University of Science and Technology
- John Howarter**,  
Purdue University
- Randolph Kirchain**,  
Massachusetts Institute of Technology
- Kaka Ma**,  
Colorado State University
- Christina Meskers**,  
Umicore
- Neale Neelameggham**,  
IND LLC
- Elsa Olivetti**,  
Massachusetts Institute of Technology
- Adam Powell**,  
Worcester Polytechnic Institute
- Fiseha Tesfaye**,  
Åbo Akademi University
- Mingming Zhang**,  
Arcelor Mittal Global R&D

## KEYNOTE & FEATURED SESSIONS

MONDAY, MARCH 11

### 2019 Light Metals Keynote Session: Aluminum Industry: Vision for the Next Decade

**Date:** Monday, March 11

**Time:** 8:00 a.m. to 11:30 a.m.

**Location:** Henry B. González Convention Center, Room 004

**Sponsored by:** TMS Light Metals Division; TMS Aluminum Committee

**Organizer:** Olivier Martin, Rio Tinto



"The Aluminium Story"  
**Chris Bayliss,**  
International Aluminium Institute



"China Aluminium Industry Picture"  
**Mo Xinda,**  
China Nonferrous Metals Industry Association



"Products of the Future—Solutions for Shaping a Sustainable World"  
**Todd Summe,**  
Novelis Inc.



"Smelter of the Future"  
**Hans Erik Vatne,**  
Norsk Hydro ASA



"The Aluminium Industry Revolution at the Door Step"  
**Vincent Christ,**  
Elysis

*The session will conclude with a panel discussion.*

## CHECK OUT THE LIGHT METALS DIGITAL LIBRARY

# Light Metals Digital Library

A new online collection of more than 5,200 technical papers from TMS's signature *Light Metals* proceedings series is now available through the TMS website. The Light Metals Digital Library includes papers published from 1971 to 2010.

View the collection at:  
[www.tms.org/LightMetalsLibrary](http://www.tms.org/LightMetalsLibrary)





**Diversity in STEM and Best Practices to Improve It**

**Date:** Monday, March 11, 2019

**Time:** 8:20 a.m. to 5:30 p.m.

**Location:** Henry B. González Convention Center, Room 301B

**Organizers:** Megan J. Cordill, Erich Schmid Institute; Matthew Korey, Purdue University; Jessica A. Krogstad, University of Illinois Urbana-Champaign; Panthea Sepehrband, Santa Clara University



"An Approach to Promote Equality and Diversity in a University Materials Department"  
**Angus Wilkinson,**  
University of Oxford, United Kingdom



"Diversity in STEM: Retention, Graduation and Beyond"  
**Andrea Hodge,**  
University of Southern California, USA



"Best Practices for Promoting Diversity in STEM through Outreach"  
**Jessica Krogstad,**  
University of Illinois, Urbana-Champaign, USA



"Half a Century of Diversifying TMS"  
**Carolyn Hansson,**  
University of Waterloo, Canada



"Navigate an Exciting STEM Career Journey through Diversity"  
**Isabella Van Rooyen,** Idaho National Laboratory, USA



"The Minority Leaders Research Collaboration Program at the Air Force Research Laboratory Materials and Manufacturing Directorate: Overview, Experiences, and Lessons Learned"  
**Asheley Blackford,**  
Air Force Research Laboratory, Wright-Patterson Air Force Base, USA



"TMS Summits on Diversity: What Have We Learned and Where Do We Go From Here?"  
**Jonathan Madison,**  
Sandia National Laboratories, USA



"The Complexities of Being LGBTQ+ In the Workplace"  
**Roberta Beal,**  
Los Alamos National Laboratory, USA



"T Time: How to Welcome and Support People of All Genders"  
**K. Cunningham,**  
ATI Specialty Alloys & Components, USA



"Coming Out in STEM"  
**Thomas Reeve,**  
Purdue University, USA

## KEYNOTE & FEATURED SESSIONS

### Magnesium Technology 2019: Keynote Session

**Date:** Monday, March 11

**Time:** 8:00 a.m. to 11:30 a.m.

**Location:** Henry B. González Convention Center, Room 005

**Sponsored by:** TMS Light Metals Division, TMS Magnesium Committee

**Organizers:** Vineet Joshi, Pacific Northwest National Laboratory; J. Brian Jordon, University of Alabama; Dmytro Orlov, Lund University; Neale Neelameggham, IND LLC



"Magnesium Alloy Sheet for Transportation Applications"  
**Christopher Romanowski,**  
Danieli FATA Hunter



"Magnesium for Automotive Lightweighting: Status and Challenges"  
**Sarah Kleinbaum,**  
U.S. Department of Energy



"Magnesium Process and Alloy Development for Applications in the Automotive Industry"  
**David Klaumuenzer,**  
Volkswagen AG



"Thermally Activated Slip in Rare Earth Containing Mg-Mn-Ce Alloy, ME10, Compared with Traditional Mg-Al-Zn Alloy, AZ31"  
**Sean Agnew,**  
University of Virginia

### Additive Manufacturing Joint Keynote Session

**Date:** Monday, March 11

**Time:** 2:30 p.m. to 5:30 p.m.

**Location:** Henry B. González Convention Center, Lila Cockrell Theater

**Sponsored by:** TMS Additive Manufacturing Committee

**Organizer:** Ryan Dehoff, Oak Ridge National Laboratory



"Solidification of Superalloys: From Single Crystals to Additive Manufacturing"  
**Tresa Pollock,**  
University of California, Santa Barbara



"Optimizing the Performance of Additively Manufactured Ti Alloy Components"  
**Hamish Fraser,**  
The Ohio State University



"Printable Alloys by Design"  
**Gregory Olson,**  
Northwestern University & QuesTek Innovations LLC



"Opportunities in Machine Learning for Additive Manufacturing"  
**Elizabeth Holm,**  
Carnegie Mellon University



"Solidification and Solid-state Transformations during Metal Additive Manufacturing under Thermo-mechanical-chemical Transients"  
**Sudarsanam Babu,**  
The University of Tennessee, Knoxville



**TUESDAY, MARCH 12**

**Materials and Manufacturing Innovation Keynote:  
Autonomous Materials Research**

**Date:** Tuesday, March 12  
**Time:** 8:30 a.m. to Noon  
**Location:** Henry B. González Convention Center,  
 Room 221D

**Organizer:** James Warren, National Institute of Standards and Technology



"Data, Disorder and Materials"  
**Stefano Curtarolo,**  
 Duke University



"Autonomous Experimentation  
 Applied to Carbon Nanotube  
 Synthesis"  
**Benji Maruyama,**  
 Air Force Research Laboratory



"SARA: Scientific Autonomous  
 Reasoning Agent to Accelerate  
 Materials Discovery"  
**Carla Gomes,**  
 Cornell University



"Towards Autonomous Materials  
 Research Systems"  
**Jason Hattrick-Simpers,**  
 National Institute of Standards and  
 Technology

*The session will conclude with a panel discussion.*

Following the panel discussion, a report on "Frontiers of Materials Research: A Decadal Study" will be held in the same room. See page 38 for details.

**TMS2019 Acta Materialia Symposium**

**Date:** Tuesday, March 12  
**Time:** 3:15 p.m. to 5:30 p.m.  
**Location:** Henry B. González Convention Center,  
 Room 217C

**Session Chair:** Carolyn Hansson, University of Waterloo



Acta Materialia Gold Medal Lecture:  
 "Stabilizing Nanostructures in  
 Metals"  
**Ke Lu,**  
 Shenyang National Laboratory for  
 Materials Science, Institute of Metal  
 Research, Chinese Academy of  
 Sciences



Acta Materialia Silver Medal Lecture:  
 "Generation of Interfacial  
 Dislocations Loops to Overcome the  
 Nucleation Barrier of Tetrahedron  
 Shaped Precipitates"  
**Xavier Sauvage,**  
 Groupe de Physique des Matériaux,  
 CNRS, Université Rouen Normandie



Acta Materialia Hollomon Award for  
 Materials and Society Lecture:  
 "When Science Matters"  
**Alexander King,**  
 Iowa State University

**TMS AND THE GERMAN  
 MATERIALS SOCIETY (DGM)  
 JOINT SYMPOSIUM PLANNED  
 FOR TUESDAY**

On Tuesday, March 12, the one-day TMS-DGM Symposium on Lightweight Metals: A Joint US-European Symposium on Challenges in Light Weighting the Transportation Industry will take place in Room 006A of the Henry B. González Convention Center. Morning sessions will focus on Aluminum topics and afternoon sessions on Magnesium. All TMS2019 attendees are welcome to attend.

## KEYNOTE & FEATURED SESSIONS

### Science Policy within the Materials Research Community

**Date:** Wednesday, March 13

**Time:** 9:00 a.m. to 5:00 p.m.

**Location:** Henry B. González Convention Center, Room 008B

**Sponsors:** TMS Education Committee and TMS Public & Governmental Affairs Committee

**Organizers:** Kathleen Chou, Ashley M. Hilmas, Peter Meisenheimer, Max Powers, and Brian Tobelmann, University of Michigan



"Opportunities and Trends in Materials Engineering Research Funding at the National Science Foundation"

**Alexis Lewis,**  
National Science Foundation



"Role of Public-Private Initiatives in Scientific Research"

**Alan Taub,**  
Lightweight Innovations for Tomorrow (LIFT) and University of Michigan



"The MGI and Materials Research Policy"

**James Warren,**  
National Institute of Standards and Technology



"Program Management in a Federal Agency"

**John Vetrano,**  
Office of Basic Energy Sciences,  
Department of Energy



"The Interplay of Materials Research, Advocacy, and Policy Development"

**Charles Ward,**  
Air Force Research Laboratory



"Advocating the Vital Importance of Support for Materials Research and Engineering Education"

**Iver Anderson,**  
Iowa State University, Ames  
Laboratory



"How Science Policy Really Gets Done in Congress"

**Scott Litzelman,**  
2017-2018 TMS/MRS Congressional  
Science & Engineering Fellow



"From the Lab to The Hill: How to Get a Job in Policy and What You'll Do When You Get There"

**Edward Herderick,**  
The Ohio State University and 2009-  
2010 TMS/MRS Congressional  
Science & Engineering Fellow

*The session will conclude with a panel discussion.*

**Effective Business Improvement Methodologies for the Minerals, Metals, and Materials Industries**

**Date:** Wednesday, March 13

**Time:** 2:00 p.m. to 5:30 p.m.

**Location:** Henry B. González Convention Center, Room 303B

**Organizers:** Barry A. Sadler, Net Carbon Consulting Pty Ltd; Eric D. Schmidt, Vallourec Star; Robert W. Hyers, University of Massachusetts



"Case Studies of Continuous Improvement Projects in the Metals Industry"  
**Cynthia K. Belt,**  
Metals Energy Management LLC



"Process Stability – the Key to Improvement in Mining, Smelting and Process Industries"  
**Keith A. Sinclair,**  
Sinclair Associates



"The Value of Investigating and Trending Minor Failures to Prevent Major Incidents"  
**Nicholas E. Cherolis,**  
Baker Engineering and Risk Consultants



"Business Development Strategies and Approaches in Minerals, Metals and Materials—an Industrial Gas Supplier's Perspective"  
**Adrian Deneys,**  
Praxair, Inc.



**ARE YOU GRADUATING FROM THE MATERIAL ADVANTAGE PROGRAM IN 2019?**

**Become a Recent Graduate Member of TMS for 2020—Free!**

Fill out our recent graduate membership application form at the TMS Member Welcome Center and your first year of membership in TMS following graduation will be free. You'll retain your Material Advantage membership through the end of 2019; your free year of membership will begin January 2020.

Visit the TMS Member Welcome Center, located outside the TMS2019 Exhibit Hall in the Henry B. González Convention Center (near registration).





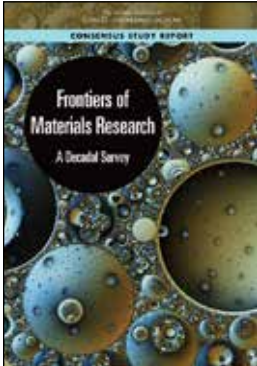
## A DEEPER LOOK AT STUDY FINDINGS

### Frontiers of Materials Research: A Decadal Study

**Date:** Tuesday, March 12

**Time:** 12:15 p.m. to 1:15 p.m.

**Location:** Henry B. González Convention Center, Room 221D



This session aims to provide the TMS community with a brief overview of the recently released report by the National Academies of Science, Engineering, and Medicine on the *Frontiers of Materials Research: A Decadal Survey*. Following a summary of the report, several members of the study committee and other leading materials researchers

will discuss their vision for the next ten years of the field during a panel discussion.

#### EVENT AGENDA

Welcome and Introductory Remarks

- **James Warren**, National Institute of Standards and Technology

Presentation on the Decadal Survey Outputs

- **Kevin Hemker**, Johns Hopkins University

Panel Discussion

- Moderator: **Steven Zinkle**, University of Tennessee

Panelists include:

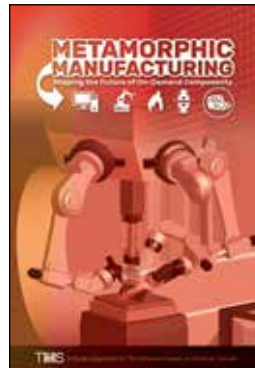
- **Linda Horton**, Department of Energy
- **Ian Robertson**, University of Wisconsin
- **Linda Sapochak**, National Science Foundation
- **Susan Sinnott**, Pennsylvania State University
- **Mark Weaver**, University of Alabama

### Metamorphic Manufacturing: Shaping the Future of On-Demand Components An Information Session with the Experts

**Date:** Wednesday, March 13

**Time:** 12:30 p.m. to 1:30 p.m.

**Location:** Henry B. González Convention Center, Room 220



Pick up your lunch in the Exhibit Hall and then sit down with the team of experts responsible for producing *Metamorphic Manufacturing: Shaping the Future of On-Demand Components*, a new TMS study released at TMS2019. Through a brief overview and informal conversation, you will gain first-hand insights into this potentially

disruptive technology that combines the incremental deformation of a metalsmith with the precision and control of intelligent machines and robotic systems.

The study is supported by the Office of Naval Research (ONR) and the Lightweight Innovations for Tomorrow (LIFT) Manufacturing Institute.

#### FEATURED PRESENTER



**Glenn Daehn**,  
Study Team Lead

Mars G. Fontana Professor of Metallurgical Engineering  
The Ohio State University

Pick up your free copy of the *Metamorphic Manufacturing* study at the TMS Member Welcome Center this week.

## PICK UP YOUR FREE COPY OF ANOTHER NEW TMS STUDY

at the TMS Member Welcome Center



*Verification and Validation of Computational Models Associated with the Mechanics of Materials* Organized by TMS on behalf of the National Science Foundation

Download for free at:  
[www.tms.org/VerificationandValidation](http://www.tms.org/VerificationandValidation)



# WHAT'S BENEATH THE DRAPE?

**A better level of understanding.**

Be the first to learn about our new  
Nano Indenter® in booth 327.





## TMS TECHNICAL DIVISION HONORARY SYMPOSIA

The following symposia, open to all TMS2019 attendees, will honor distinguished members of the minerals, metals, and materials community.

### Solidification Processing of Light Metals and Alloys: An MPMD Symposium in Honor of David StJohn

**Dates:** Monday, March 11, to Wednesday, March 13  
**Location:** Henry B. González Convention Center, Room 006C

**Symposium Organizers:** Mark A. Easton, Royal Melbourne Institute of Technology (RMIT) University; Ma Qian, RMIT University; John F. Grandfield, Grandfield Technology Pty Ltd; Norbert Hort, Helmholtz-Zentrum Geesthacht; Mark Roderic Jolly, Cranfield University



David StJohn

The major theme in Professor David StJohn's career was the study of phase transformations, particularly solidification phenomena. Of particular focus was light metal alloys: aluminum alloys, magnesium alloys and, more recently, titanium alloys. His most recognized and awarded contribution has been in nucleation and grain refinement, but

he has made contributions to a wide range of solidification problems including defect formation, melt treatment, and casting alloy design.

To cover the main themes of his research career, sessions will cover the following topics:

- Nucleation and grain refinement of light alloys
- Eutectic and peritectic solidification
- Defect formation in castings: porosity and hot tearing
- Solidification under external fields
- Magnesium casting and alloys
- Aluminium casting and alloys
- Solidification during additive manufacturing
- Approaches to collaborative research

### Interfaces in Structural Materials: An MPMD Symposium in Honor of Stephen M. Foiles

**Dates:** Monday, March 11, to Thursday, March 14  
**Location:** Henry B. González Convention Center, Room 302C

**Symposium Organizers:** Fadi Abdeljawad, Sandia National Laboratories; Eric R. Homer, Brigham Young University; Elizabeth A. Holm, Carnegie Mellon University; Mark D. Asta, University of California Berkeley



Stephen M. Foiles

The key to the development of advanced materials with tailored microstructures and architectures is a detailed understanding of interfaces. In particular, the significance of internal (grain and phase) boundaries as well as free surfaces becomes more dominant in applications where a reduction of system size or scale of

microstructure is desired to optimize properties. It is to this field that Dr. Stephen M. Foiles made significant contributions over a period of more than 35 years. The goal of this symposium is to bring together researchers across a wide range of disciplines to communicate recent advancements pertaining to the study of materials interfaces (free surfaces, solid-liquid, grain boundaries) both computationally and experimentally. The contributions of Foiles to the development of interatomic potentials for atomistic simulations and study of materials interfaces will be highlighted.

This symposium will cover topics such as:

- Interatomic potential development and its use to model materials behavior
- Thermodynamics of interfaces
- Dynamical behavior of interfaces (crystal surfaces, grain boundaries (GB), phase boundaries, solid-liquid)
- Phase transitions and microstructural evolution
- Interface properties (energy, mobility, etc.)
- Interface segregation/adsorption
- Interface-defect (dislocation/vacancy) interactions (radiation, mechanical, etc.)

**Green Materials Engineering: An EPD Symposium in Honor of Sergio Monteiro**

**Dates:** Monday, March 11, to Wednesday, March 13  
**Location:** Henry B. González Convention Center, Room 008A

**Symposium Organizers:** Shadia Jamil Ikhmayies, Isra University; Jian Li, CanmetMATERIALS; Carlos Mauricio Vieira, State University of the North Fluminense; Jean Margem\*, State University of the North Fluminense; Fabio Braga, Military Institute of Engineering

\* Passed away March 2018



Sergio Monteiro

The main focus of this symposium is green materials, comprising: natural composites, bio-inspired armors, waste added clay ceramics, lignocellulosic fibers, and biodegradable polymers. Also part of the technical scope of this symposium is any type of natural material that could be related to engineering applications. This TMS Extraction & Processing Division (EPD) symposium will be held in honor of Sergio Monteiro, professor at the Military Institute of Engineering, IME, Brazil.

# WHAT DO OUR MEMBERS HAVE TO SAY ABOUT US?

When TMS asked its members to describe the Society in one word, we received a variety of responses. The words most frequently used are pictured here. Come to the TMS Member Welcome Center to learn more about your TMS membership!



## SPECIAL LECTURES

MONDAY, MARCH 11

### Extraction & Processing Division Distinguished Lecturer

**Date:** Monday, March 11

**Time:** 8:00 a.m. to 8:55 a.m.

**Location:** Henry B. González Convention Center, Room 213B



**Speaker:** Sridhar Seetharaman, Colorado School of Mines, USA

**Lecture Title:** "The Importance of Transient Phenomena in Metallurgical Processes"

**About the Presentation:** Metallurgical processes undergo a transient trajectory towards equilibration, and the specifics of this can often have an influence on the outcome on the rate of a reaction, resulting micro-structure, or yield. The transient trajectory can be influenced by factors such as impurities in raw materials, thermal history, and evolving reaction areas. This talk will review examples from slag/metal reactions, precipitations in the melt, and oxidization of cases wherein studies of the details of transient trajectory paths reveal useful information on how metallurgical processes can be affected.

### William Hume-Rothery Award

**Date:** Monday, March 11

**Time:** 8:00 a.m. to 8:40 a.m.

**Location:** Henry B. González Convention Center, Room 304B



**Speaker:** Mark D. Asta, University of California, Berkeley, USA

**Lecture Title:** "Order within Disordered Materials – Insights into the Nature and Impact of Short-Range Order in Concentrated Solid Solutions"

**About the Presentation:** Atomistic simulation methods have led to a range of fundamental insights into structure-property relations in configurationally disordered materials, and have become an indispensable tool in computationally accelerated materials design. This talk will provide a brief overview of the general approaches underlying such calculations, highlighting their application in the modeling of properties of concentrated alloy solid solutions. A specific focus will be on the role of short-range order (SRO) - a structural characteristic of solid solutions that has gained renewed attention in the context of multi-principal element alloys, due to its potential impact on stability and mechanical behavior. Insights into the nature of SRO in oxide and metal solid solutions is discussed, as well as its relevance in the context of properties ranging from radiation effects to mechanical deformation. The characteristics of SRO derived from computational simulation are compared to recent experimental observations employing modern characterization tools capable of probing local structure.

## TUESDAY, MARCH 12

**Structural Materials Division Luncheon Lecture\*****Date:** Monday, March 11**Time:** 1:00 p.m. to 2:30 p.m.**Location:** Grand Hyatt San Antonio, Lonestar Ballroom A

**Speaker:** Stephen M. Foiles, Sandia National Laboratories, USA  
**Lecture Title:** "Molecular Dynamics: With Great Power Comes Great Responsibility"

**About the Presentation:** Molecular dynamics (MD), which follows the classical motion of individual atoms, has become a widely used tool in computational materials science employed to predict a wide range of materials properties and fundamental atomic-scale mechanisms. The great power of MD is that the atoms move in response to their mutual interactions and the external driving forces and the system evolves as the dynamics dictate. No assumptions about underlying mechanisms need to be made; the underlying mechanisms are predicted. Some of the achievements of this approach will be highlighted. However, those wielding this powerful tool have a great responsibility to understand how closely the simulated system actually corresponds to real materials. This uncertainty quantification (UQ) is a very challenging problem because MD is based on a number of underlying approximations including the Born-Oppenheimer approximation, the representation of a material with a mere few million atoms evolving for a few nanoseconds and the uncontrolled approximations inherent in describing the interatomic interactions to name but a few. UQ for MD is a largely ignored field, but one that needs to be addressed if MD is to evolve beyond a qualitative tool to a predictive tool that can impact material design and qualification. Some initial ideas to tackle this problem will be presented along with a discussion of some of the major hurdles ahead.

*\*This lecture is open to all meeting attendees, but only those who purchased tickets in advance will receive a catered lunch. Luncheon tickets may be purchased at the Registration Desk until 10:00 a.m. on Sunday, March 10.*

**Japan Institute of Metals International Scholar****Date:** Tuesday, March 12**Time:** 10:30 a.m.**Location:** Henry B. González Convention Center, Room 302B

**Speaker:** Sakiko Kawanishi, Tohoku University, Japan  
**Lecture Title:** "An Approach for Solubility Measurement of SiC in Molten Silicon and its Alloy by Real-Time Interference Observation"

**About the Presentation:** Solubility of a component in molten metals and alloys is one of the important materials properties for various applications. In this study, solubility measurement in molten metal at high temperature was performed by dissolving target crystals under a real-time imaging of interference patterns of the crystal. An optical microscope equipped with a heating chamber was used for the observation. The dissolved amount of the crystal was measured in real-time from the evolution of the He-Ne laser interference patterns, used to track the liquid/SiC interface. Temperature dependence of SiC solubility in molten silicon was evaluated up to 1873 K. Solubility of SiC in Fe-36 mol% Si at 1573 K was also assessed. Both measurements, ranging from 0.007 to 0.5 mol% of carbon, reproduced the reported solubilities. The technique can be applied for various systems. Details of observation technique and evaluated results will be presented.



**Extraction & Processing Division/Materials Processing & Manufacturing Division Luncheon\***

**Date:** Tuesday, March 12  
**Time:** Noon to 2:00 p.m.  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom A



**Speaker:** Toru H. Okabe, University of Tokyo, Japan  
**Lecture Title:** "Recycling Precious Metals and Rare Metals from Scraps"

**About the Presentation:** In this talk, the current status of recycling of precious metals and rare metals (or critical metals) will be reviewed, and the related processing technologies will be introduced. Specifically, recent research on the recycling of titanium, rhenium, and some precious metals from scraps will be introduced. The possibility of next-generation recycling technologies of critical metals will also be discussed from a multilateral perspective. Further, recent progress in the refining and recycling processes of titanium and other rare metals will be introduced. If time permits, possible applications of recycling techniques, especially for titanium and precious metal recycling, in practical industrial processes will also be discussed.

*"This lecture is open to all meeting attendees, but only those who purchased tickets in advance will receive a catered lunch. Luncheon tickets may be purchased at the Registration Desk until 10:00 a.m. on Monday, March 11."*

**Young Professional Tutorial Luncheon Lecture**

**Date:** Tuesday, March 12  
**Luncheon:** Noon to 12:45 p.m. (Tickets can be purchased at the registration desk until 10:00 a.m. Monday, March 11)  
**Lectures:** 12:45 p.m. to 2:00 p.m. (No tickets required)  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom C



**Speaker:** Elsa Olivetti, Massachusetts Institute of Technology  
**Lecture Title:** "Data Mining to Guide Synthesis Towards Resource-Effective Materials, Processes, and Systems"

**About the Presentation:** Advances in computational materials design have enabled rapid screening for desirable properties of both real and virtual compounds. However, the pace of commercially realized advanced materials is still limited by trial-and-error synthesis techniques. The goal of this research project is to advance computational learning around materials synthesis approaches by creating a predictive synthesis system for advanced materials design and processing. To date we have automated extraction of recipes from over 1.2 million published scientific articles through body text extraction, focused on synthesis of inorganic materials using primarily machine learning approaches. We have performed text and data mining with deep learning techniques including recurrent and convolutional neural network approaches that enable comprehensive search across all materials and types of synthesis. Examples demonstrating the value of this dataset for informing synthesis will be presented including for titania nanostructures, MnO<sub>2</sub> polymorphs, and even the possibility of new synthesis parameter generation. These approaches may also be coupled with techno economic models of manufacturing processes to learn how new materials development may scale from laboratory to implementation.



**Speaker:** Ashley D. Spear, University of Utah  
**Lecture Title:** "Data-Driven Materials Science: Successes, Challenges, and Opportunities"

**About the Presentation:** Thanks to rapidly expanding capabilities in manufacturing, materials characterization, and computational modeling, the materials community has begun to gain unprecedented access to multi-dimensional and multi-resolution data that can, at times, seem unwieldy to manage, process, and analyze. With access to such large and rich data comes a wonderful opportunity to combine materials science with computer and data science. This lecture will present some recent success stories from the community on the use of data-driven approaches to unveil, or even predict, material phenomena through the use of image-processing algorithms, multi-dimensional correlation analyses, machine learning, and more. In the context of these success stories, the lecture will highlight some of the challenges associated with data-driven approaches, as well as opportunities to leverage such approaches to continue to improve our understanding of and ability to predict complex material behavior.



## WEDNESDAY, MARCH 13

## Light Metals Division Luncheon\*

**Date:** Wednesday, March 13**Time:** Noon to 2:00 p.m.**Location:** Grand Hyatt San Antonio, Lonestar Ballroom A

**Speaker:** Kevin Anderson, Mercury Marine, USA  
**Lecture Title:** "Technological Advancements in the Secondary Aluminum Industry"

**About the Presentation:** Our world will continue to need primary aluminum for years to come. However, particularly in economies that have a long history of aluminum products, secondary aluminum is playing an increasing role. In fact, since 2001, secondary aluminum production in the United States surpassed primary aluminum production with many positive benefits such as lower cost, energy savings, and environmental stewardship. There are numerous high-level and plant-floor themes that drive technological advancement in the secondary aluminum industry. These include, but are not limited to, environmental protection, cost reduction, energy savings, product lifecycle management of aluminum intensive structures, improved mechanical properties, improved metal cleanliness, accurate scrap sortation, scrap stream management, accurate and rapid chemical composition determination, and improved process understanding through data science. During the presentation, Anderson will highlight numerous production relevant technologies that have been either adapted from other industries or developed within the industry to address these themes and continue the advancement of the secondary aluminum industry.

*\*This lecture is open to all meeting attendees, but only those who purchased tickets in advance will receive a catered lunch. Luncheon tickets may be purchased at the Registration Desk until 10:00 a.m. on Tuesday, March 12.*

## Institute of Metals/Robert Franklin Mehl Award

**Date:** Wednesday, March 13**Time:** 12:15 p.m. to 1:15 p.m.**Location:** Henry B. González Convention Center, Room 303C

**Speaker:** Hael Mughrabi, University Erlangen-Nürnberg, Germany  
**Lecture Title:** "Revisiting 'Steady-State' Monotonic and Cyclic Deformation: Emphasizing the Quasi-Stationary State of Deformation"

**About the Presentation:** High-temperature creep, cyclic deformation in saturation, and a number of technologically important processes are typical examples of so-called "steady-state" deformation. In these cases, it is usually assumed that the deformation-induced microstructure undergoes no further changes. However, clear evidence shows that non-negligible microstructural changes occur in steady-state high-temperature creep and in cyclic saturation. Thus, "steady-state" deformation is actually a quasi-stationary deformation. A deeper analysis reveals a persistent slight increase of the dislocation density, due mainly to geometrically necessary dislocations in the subgrain boundaries which transform gradually into sharper boundaries with higher misorientations. The analysis clarifies, as a byproduct, specific effects which arise from the increasing heterogeneity of the dislocation pattern. Thus, a marked decrease of the arrangement factor "alpha" in the Taylor flow-stress is noted, as predicted by the so-called composite model. This effect is compensated partially by the increase of the dislocation density. Thus the flow stress remains rather insensitive to subtle microstructural changes.

## HELP US DETERMINE NEXT YEAR'S AWARD LECTURERS

Nominations are now being accepted for a number of TMS society and division awards, including several TMS2020 award lecturers.

Submit your nominees by April 1. Visit [www.tms.org/awards](http://www.tms.org/awards) for more information.

**Meet a Mentor**



**Date:** Monday, March 11  
**Time:** 5:00 p.m. to 6:30 p.m.  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom B

Seasoned professionals representing a combination of academic, government and industry career backgrounds will lead small discussion groups of young professionals and students embarking on their professional materials science careers. Mentors from a variety of technical, career, and social backgrounds will be on hand to answer questions and provide guidance and advice to mentees. Advance reservations required.

**ADVANCE YOUR CAREER:  
 APPLY FOR A TMS YOUNG  
 PROFESSIONAL AWARD**

TMS offers a number of awards to help early-career professionals gain new experiences and establish a name in the field.

**Apply by April 1, 2019:**

- NEW! TMS Frontiers of Materials Award
- AIME Robert Lansing Hardy Award
- Early Career Faculty Fellow Award

**Apply by June 15, 2019:**

- Emerging Leaders Alliance Program

**Apply by August 15, 2019:**

- TMS Young Leaders International Scholar Award
- TMS Young Leaders Professional Development Award

For more information on award criteria or the application process, visit the "Young Professional Awards" section at [awards.tms.org](http://awards.tms.org)

**Preparing a Winning Application Package Workshop**

**Date:** Tuesday, March 12  
**Time:** 4:00 p.m. to 6:00 p.m.  
**Location:** Grand Hyatt San Antonio, Mission A

**Instructors:** Mohsen Asle Zaeem, Colorado School of Mines; Janelle P. Wharry, Purdue University; additional instructors to be announced  
**Sponsored by:** TMS Young Professionals Committee

In this workshop, instructors from a national laboratory, university, and industry will share their experiences in obtaining and/or recruiting entry-level positions (postdocs, tenure-track faculty positions, etc.) and help guide the young professional on their journey from recent graduate to career professional. Pre-registration required to participate.

**Young Professionals Committee Meeting**

**Date:** Tuesday, March 12  
**Time:** 8:00 a.m. to 9:30 a.m.  
**Location:** Grand Hyatt San Antonio, Bowie ABC

The mission of the Young Professionals Committee is to create opportunities and provide avenues for young professionals to increase their involvement in TMS. This committee meeting is open to all TMS members, age 40 or younger, who have graduated.



**INSPIRING  
MINDS.**

**BUILDING  
LEADERS.**

**SHAPING OUR  
PROFESSION.**

**Learn about more success stories made possible by the TMS Foundation—and how you can be part of future ones.**



“TMS membership and the TMS Foundation have been **instrumental in my success** as a materials engineer and materials educator. The Society and the awards provided by the Foundation have allowed me to **participate in and direct the technical discussions** that impact our community.”

—**Jennifer Carter**,  
Case Western Reserve University  
*2019 TMS/FEMS Young Leaders  
International Scholar*

Stop by the TMS Member Welcome Center, located outside the TMS2019 Exhibit Hall in the Henry B. González Convention Center (near registration), to learn more about the TMS Foundation. Or visit **[www.TMSFoundation.org/Contribute](http://www.TMSFoundation.org/Contribute)** to offer your support and make an online donation.

**[www.TMSFoundation.org](http://www.TMSFoundation.org)**

## NETWORKING & SOCIAL EVENTS

### SUNDAY, MARCH 10

#### President's Welcoming Reception

**Date:** Sunday, March 10  
**Time:** 6:00 p.m. to 7:00 p.m.  
**Location:** Henry B. González Convention Center, Hall 4A

Kick off the TMS 2019 Annual Meeting & Exhibition with this social networking event open to all attendees. This is a relaxed opportunity to meet with some of your global colleagues before presentations begin on Monday. Refreshments will be provided.

#### LGBTQ+ and Allies Networking Mixer

**Date:** Sunday, March 10  
**Time:** 8:00 p.m. to 11:00 p.m.  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom A

Enjoy an evening of informal networking in a safe space to celebrate shared experiences as TMS LGBTQ+ individuals and allies. Cash bar, with light snacks provided. Organized by the TMS Pride of the TMS Diversity Committee. Champion Level Sponsors: GE Research and the National Institute of Standards & Technology.

### MONDAY, MARCH 11

#### Lunch in the Exhibit Hall

**Date:** Monday, March 11  
**Time:** 1:00 p.m. to 2:30 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

Enjoy a complimentary lunch in the exhibit hall and browse exhibitor displays between the morning and afternoon technical sessions.

#### Exhibit Opening Reception and Poster Session



**Date:** Monday, March 11  
**Time:** 5:30 p.m. to 7:00 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

All attendees are invited to meet in the exhibit hall for appetizers, beverages, and networking with exhibitors, poster presenters, and other colleagues on the first day of the TMS2019 Exhibition.

### TUESDAY, MARCH 12

#### Lunch in the Exhibit Hall

**Date:** Tuesday, March 12  
**Time:** 11:30 a.m. to 1:30 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

Enjoy a complimentary lunch in the exhibit hall and browse exhibitor displays between the morning and afternoon technical sessions.

#### Exhibit Hall Happy Hour and Poster Session

**Date:** Tuesday, March 12  
**Time:** 5:30 p.m. to 7:00 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

All attendees are invited to gather in the exhibit hall for appetizers, beverages, and networking with exhibitors, poster presenters, and colleagues.

### WEDNESDAY, MARCH 13

#### Fresh Coffee, Fresh Ideas: Diversity and Inclusion Breakfast\*



**Date:** Wednesday, March 13  
**Time:** 7:00 a.m. to 8:00 a.m.  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom A

Organized by the TMS Diversity Committee, this event offers an opportunity for TMS members to network and discuss issues related to diversity, inclusion, and engagement in the minerals, metals, and materials professions.

*\*Tickets required. Tickets must be purchased by Monday at 5:00 p.m. at the Registration Desk.*

#### Lunch in the Exhibit Hall

**Date:** Wednesday, March 13  
**Time:** 11:30 a.m. to 1:30 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

Enjoy a complimentary lunch in the exhibit hall and browse exhibitor displays between the morning and afternoon technical sessions.



### 2019 TMS-AIME Awards Ceremony & Banquet



**Date:** Wednesday, March 13  
**Reception Time:** 5:30 p.m. to 6:00 p.m.  
**Awards Ceremony:** 6:00 p.m. to 7:30 p.m.  
**Location for Reception and Awards Ceremony:**  
 Henry B. González Convention Center, Lila Cockrell Theatre  
**Banquet\*:** 7:30 p.m. to 8:30 p.m.  
**Afterglow Reception\*:** 8:30 p.m. to 10:00 p.m.  
**Location for Banquet and Afterglow Reception:**  
 Grand Hyatt San Antonio, Lonestar Ballroom ABC

Show your support for colleagues who will be accepting awards from TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) at the 2019 TMS-AIME Awards Ceremony & Banquet. There is no cost to attend the awards ceremony to honor those individuals who are being recognized for excellence in their fields. If you would like to attend the banquet following the awards ceremony, however, you must purchase a ticket. The opening reception for this event is sponsored by Zeiss.

*\* Tickets are required to attend the Banquet and the Afterglow Reception. Tickets must be purchased by Tuesday at 10:00 a.m. at the TMS Registration Desk.*

## STUDENT EVENTS

### TMS2019 Materials Bowl



**Date:** Sunday, March 10  
**Time:** 2:00 p.m. to 6:00 p.m.  
**Location:** Henry B. González Convention Center, Lila Cockrell Theatre

Even if you aren't competing in the materials-themed quiz-show competition, you're welcome to attend the elimination rounds or the final championship round. Play along to test your materials science and engineering knowledge or cheer on your favorite school. This event is sponsored by Goodfellow.

### Student Networking Mixer

**Date:** Sunday, March 10  
**Time:** 7:00 p.m. to 8:30 p.m.  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom BC

Take a break and have some fun at this informal social event. Students will have the opportunity to interact with each other and with professionals in a relaxed setting. Refreshments will be provided.

### Technical Division Student Poster Contest Session

**Date:** Monday, March 11  
**Time:** 5:30 p.m. to 7:00 p.m.  
**Location:** Henry B. González Convention Center, Hall 3

Stop by and browse the student poster displays at your leisure or attend the official judging session to ask questions of the participants. If you are participating in the student poster contest, you must be present at the judging session to answer questions about your work.

### Student Career Forum



**Date:** Tuesday, March 12  
**Time:** 2:00 p.m. to 4:00 p.m.  
**Location:** Grand Hyatt San Antonio, Lonestar Ballroom B

"When should I start my job search?" "Should I continue to graduate school or begin my career?" "How important is networking to my career?" If you find yourself asking questions like these about your future, then you should attend the Student Career Forum. Organized by the TMS Young Professional Committee, this session will feature speakers from various stages of their careers and diverse materials science backgrounds to discuss how to navigate a successful career path in the fields of minerals, metals, and materials.





### ON DISPLAY NOW IN THE TMS2019 EXHIBIT HALL

TMS2019 is home to the third TMS Bladesmithing Competition, which challenges teams of university students to produce a blade by hand hammering or trip hammer forging. The teams' entries will be on display in the TMS2019 Exhibit Hall during regular exhibit hours, and all TMS2019 attendees are encouraged to explore the collection.

The winning teams will be announced during a special awards ceremony on Tuesday, March 12, from 5:00 p.m. to 5:30 p.m. in the Lila Cockrell Theatre of the Henry B. González Convention Center. The ceremony is open to all TMS2019 attendees.

### GOOD LUCK TO EACH OF OUR PARTICIPATING TEAMS:

- **Centro de Investigación y de Estudios Avanzados,**  
"CINVESTAV's Kukri"
- **Colorado School of Mines,**  
"Rain Drop Pattern Chef Knife"
- **Drexel University,**  
"Occam's Razor"
- **Friederich-Schiller-University Jena,**  
"Hugin"
- **Illinois Institute of Technology, Armour College of Engineering,**  
"Kunai"
- **Indian Institute of Technology, Bombay,**  
"Talwar"
- **Indian Institute of Technology, Madras,**  
"Indian Katar"
- **Institut Teknologi Sepuluh Nopember,**  
"The Karembit, Indigenous Martial Arts Weapon of Indonesia"
- **McMaster University,**  
"The Mighty Gladius"
- **Michigan State University,**  
"An Agricultural Tool, and Then Some"
- **Michigan Technological University,**  
"MTU Kukri"
- **Missouri University of Science and Technology,**  
"Stahlzahn"
- **Montana Technological University,**  
"Renaissance Dagger"
- **Montanuniversität Leoben,**  
"Historically Inspired Broken Back Seax"
- **New Mexico Institute of Mining and Technology,**  
"Second Heat"
- **Norwegian University of Science and Technology,**  
"T13727 Viking Sword Reproduction"
- **Oregon Institute of Technology,**  
"Viking's Little Helper"
- **Oregon State University,**  
"Raindrop San Mai Damascus Bowie"
- **South Dakota School of Mines & Technology,**  
"Crucible Steel Dagger"
- **Universidad Nacional Autónoma de México,**  
"Iztactepostli"
- **Universidad San Francisco de Quito,**  
"Dragon Dagger"
- **University of Alberta,**  
"Double-edged Sword"
- **University of California, Berkeley,**  
"Ax L. Rose"
- **University of California, Irvine,**  
"Utilitarian Kitchen Chopper"
- **University of Florida,**  
"DECAPIGATOR"
- **University of Idaho,**  
"Fire Creek Forge Bowie Knife"
- **University of Minnesota Twin-Cities,**  
"Seax Blade"
- **University of North Texas,**  
"Anglo-Saxon Broken-Back Seax"
- **University of Pittsburgh, Team #1,**  
"PittSmiths Kukri"
- **University of Pittsburgh, Team #2,**  
"It's a Wonderful Knife"
- **University of Tennessee at Knoxville,**  
"Volsung"
- **University of Texas at Austin,**  
"Alpha Blade"
- **University of Utah,**  
"Damascus Steel Swept Rapier"
- **Virginia Polytechnic Institute and State University,**  
"World War 1 Trench Knife Replica"



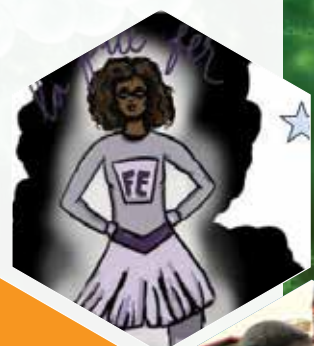
# MATERIALS™ EXPLORERS

**Are you interested in becoming  
a STEM Ambassador?**

Use *Materials Explorers™* to inspire students  
in your community about how scientists and  
engineers are changing the world.

**For more information or to get involved  
with the program, visit TMS staff at the  
Member Welcome Center conveniently  
located near Registration.**

**[www.materials-explorers.org](http://www.materials-explorers.org)**







**TMS 2019**  
**TMS-AIME**  
**AWARDS CEREMONY**  
**& BANQUET**



**James Foley**

**INSTALLATION OF THE 2019 TMS PRESIDENT:**

During the 2019 TMS-AIME Awards Ceremony, TMS will install James Foley as the Society's 2019 president. Foley is currently Sigma-1 Group Leader at Los Alamos National Laboratory and has been employed there since 2003. He received his B.S. in 1988, M.S. in 1991 and Ph.D. in 1997 in metallurgical engineering from the University of Wisconsin-Madison. He was a postdoctoral fellow at the U.S. Department of Energy's Ames Laboratory from 1997 through 1998. From 1998 through 2003, he was an associate scientist at Ames Laboratory. His research interests cover amorphous alloys, lead-free solder, aluminum alloys, beryllium, and powder metallurgy. Foley has been a member of TMS since 1987 and served on the Program Committee as Chair from 2006 to 2009. He was the Programming Coordinating Committee Chair for MS&T '06, and from 2013 to 2016 he served as the Materials Processing & Manufacturing Division (MPMD) Council Chair.

SCHEDULE OF EVENTS
<b>Date:</b> Wednesday, March 13
<b>Reception:</b> 5:30 p.m. (Sponsored by Zeiss) (Open to all TMS2019 attendees)
<b>Awards Ceremony:</b> 6:00 p.m. (Open to all TMS2019 attendees)
<b>Awards Ceremony and Reception Location:</b> Henry B. González Convention Center, Lila Cockrell Theatre
<b>Banquet:</b> 7:30 p.m. (Tickets required.)
<b>Afterglow Reception:</b> 8:30 p.m. (Ticket included when purchasing a banquet ticket)
<b>Location:</b> Grant Hyatt San Antonio, Lonestar Ballroom

*The reception and ceremony are open to all meeting attendees, but tickets are required for the dinner and afterglow portion of the evening. Tickets must be purchased by Tuesday at 10:00 a.m. at the Registration Desk.*

The 2019 TMS-AIME Awards Ceremony and Banquet will be an elegant event, designed to honor the significant professional achievements of members of the minerals, metals, and materials communities. The ceremony includes presentations of awards from both TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), of which TMS is a member society. Additional awards, including Acta Materialia awards and the Brimacombe Prize, will also be presented to TMS members.

The evening will consist of four parts. First, award recipients and their guests will be welcomed at a cocktail reception. Following the reception, participants will be seated for the awards ceremony, where individual recipients will be honored for their accomplishments. After the ceremony, those participants who have purchased banquet tickets will proceed to the Grand Hyatt for a formal dinner. Attendees who purchased a banquet ticket will also receive a ticket to the Afterglow Reception which immediately follows dinner. Reception attendees can network while enjoying after-dinner drinks and dessert.

**AWARDS CEREMONY PRESENTERS**

The ceremony will be hosted by Kevin Hemker, 2018 TMS President, and will include comments by Hemker and James Foley, 2019 TMS President. In addition, the following presenters will announce the awards:

- **Roland Moreau**, ExxonMobil and 2019 AIME President
- **Michele Lawrie-Munro**, AIME Executive Director
- **Carolyn Hansson**, University of Waterloo and Acta Materialia Executive Secretary
- **George T. "Rusty" Gray III**, Los Alamos National Laboratory and Acta Materialia Chair & Treasurer
- **Brian Thomas**, University of Illinois and Brimacombe Prize Committee
- **Megan Cordill**, Erich Schmid Institute and 2015 MPMD Young Leaders Professional Development Award recipient
- **Peter Voorhees**, Northwestern University, 2011 Bruce Chalmers Award recipient, and 2013 TMS Fellow
- **Tresa Pollock**, University of California, Santa Barbara, 2005 TMS President, and 2009 TMS Fellow

## SOCIETY AWARDS

### TMS FELLOWS – CLASS OF 2019

- **Thomas Bieler**  
Professor and Director  
Michigan State University
  - **M. Grace Burke**  
Professor and Director  
University of Manchester
  - **Frank Crossley\***  
Retired  
Aerjet Propulsion Research  
Institute
  - **Dennis Dimiduk**  
Chief Technologist  
BlueQuartz Software LLC
  - **Roderick Guthrie**  
Director of McGill Metals  
Processing Centre  
McGill University
  - **Elizabeth Holm**  
Professor  
Carnegie Mellon University
  - **Nack Joon Kim**  
Professor  
Pohang University of  
Science and Technology
  - **Alan Taub**  
Professor  
University of Michigan
  - **Dan Thoma**  
Director Grainger Institute  
for Engineering  
University of Wisconsin –  
Madison
- ### BRIMACOMBE MEDALIST – CLASS OF 2019
- **Sean Agnew**  
Professor  
University of Virginia
  - **Raymundo Arroyave**  
Professor  
Texas A&M University
  - **Irene Beyerlein**  
Professor  
University of California,  
Santa Barbara
  - **Jian Luo**  
Professor  
University of California, San  
Diego
  - **Jonathan Spowart**  
Senior Materials Research  
Engineer  
United States Air Force
  - **Dallas Trinkle**  
Associate Professor  
University of Illinois Urbana  
Champaign

### APPLICATION TO PRACTICE AWARD

- **Don Lipkin**  
Senior Principal Scientist  
GE Global Research

### BRUCE CHALMERS AWARD

- **Dieter Herlach**  
Full Professor  
German Aerospace Center

### MORRIS COHEN AWARD

- **William Gerberich**  
Professor Emeritus  
University of Minnesota

### FRANK CROSSLEY DIVERSITY AWARD

- **Olivia Underwood**  
Product Realization Team  
Leader  
Sandia National  
Laboratories

### ELLEN SWALLOW RICHARDS DIVERSITY AWARD

- **Michelle Buchanan**  
Deputy for Science &  
Technology  
Oak Ridge National  
Laboratory

### EARLY CAREER FACULTY FELLOW AWARD

- **Elsa Olivetti**  
Assistant Professor  
Massachusetts Institute of  
Technology
- **Ashley Spear**  
Assistant Professor  
University of Utah

### JULIA AND JOHANNES WEERTMAN EDUCATOR AWARD

- **David Van Aken**,  
Professor  
Missouri University of  
Science and Technology

### WILLIAM HUME-ROTHERY AWARD

- **Mark Asta**  
Professor  
University of California,  
Berkeley

### INSTITUTE OF METALS LECTURER & ROBERT FRANKLIN MEHL AWARD

- **Hael Mughrabi**  
Professor Emeritus  
University of Erlangen-  
Nuernberg

### LEADERSHIP AWARD

- **James Warren**  
Director, Materials Genome  
Program  
National Institute of  
Standards and Technology

### ALEXANDER SCOTT DISTINGUISHED SERVICE AWARD

- **Robert Hyers**  
Professor  
University of Massachusetts

### OLEG D. SHERBY AWARD

- **Michael Mills**  
Professor  
The Ohio State University

## AIME AWARDS

### AIME HONORARY MEMBERSHIP

- **K. Linga Murty**  
Professor  
North Carolina State  
University

### TMS/SME/AIME JAMES DOUGLAS GOLD MEDAL

- **Jiann-Yang "Jim" Hwang**  
Professor  
Michigan Technological  
University

### AIME ROBERT LANSING HARDY AWARD

- **Saryu Fensin**  
Scientist  
Los Alamos National  
Laboratory
- **Nan Li**  
Staff Scientist  
Los Alamos National  
Laboratory

### AIME CHAMPION H. MATHEWSON AWARD

- **Irene Beyerlein**  
Professor  
University of California,  
Santa Barbara
- **Christoph Fahrenson**  
Technical Staff Member  
Technical University of  
Berlin
- **Marko Knezevic**  
Associate Professor  
University of New  
Hampshire
- **Martin Lentz**  
Project Manager  
Hydro Aluminum Rolled  
Products GmbH

- **Walter Reimers**  
Professor  
Technical University of  
Berlin
- **Marcel Risse**  
Development Engineer  
BSH Home Appliances  
Corporation
- **Jonathan Cormier**  
Associate Professor  
ISAE-ENSMA and Institut  
Pprime
- **Ana Casanova Gomez**  
Student  
University of Cambridge
- **Jean-Michel Franchet**  
Materials & Processes  
Engineer  
Safran Tech
- **Stephane Pierret**  
Engineer  
Safran Aircraft Engines
- **Tresa Pollock**  
Professor  
University of California,  
Santa Barbara
- **Damien Texier**  
CNRS Researcher  
Institut Clement Ader, UMR  
CNRS
- **Patrick Villechaise**  
Senior Researcher  
Institut Pprime – CNRS

### AIME HENRY DEWITT SMITH SCHOLARSHIP

- **Brady Dowdell**  
Student  
North Carolina State  
University
- **Pranjali Nautiyal**  
Student  
Florida International  
University

## OTHER AWARDS

### ACTA MATERIALIA GOLD MEDAL AWARD

- **Ke Lu**  
Professor and Director  
Institute of Metal Research

### ACTA MATERIALIA SILVER MEDAL AWARD

- **Xavier Savage**  
Deputy Director  
CNRS - GPM - University  
Rouen Normandy

\* Passed away since nominated.



## ACTA MATERIALIA HOLLOMAN MATERIALS & SOCIETY AWARD

- **Alexander H. King**  
Professor  
Iowa State University

## ACTA MATERIALIA UNDERGRADUATE SCHOLARSHIP

- **Rafael Rodriguez De Vecchis**  
Student  
University of Pittsburgh
- **Keith Coffman**  
Student  
Georgia Institute of Technology

## BRIMACOMBE PRIZE

- **John Grandfield**  
Director  
Grandfield Technology Pty Ltd

### DIVISION AWARDS

#### EXTRACTION & PROCESSING DIVISION (EPD)

## EPD DISTINGUISHED LECTURER AWARD

- **Sridhar Seetharaman**  
Professor and Associate  
Vice President for Research  
Colorado School of Mines

## EPD DISTINGUISHED SERVICE AWARD

- **Jiann-Yang "Jim" Hwang**  
Professor  
Michigan Technological  
University

## EPD SCIENCE AWARD

- **Ata Fallah-Mehrjardi**  
Senior Manager  
Aurubis AG
- **Taufiq Hidayat**  
University of Queensland
- **Peter Hayes**  
Professor and Program  
Leader  
University of Queensland
- **Evgueni Jak**  
Professor  
University of Queensland

## EPD TECHNOLOGY AWARD

- **Adam Gesing**  
President  
Gesing Consultants Inc.

- **Subodh Das**  
CEO & Founder  
Phinix LLC

## EPD PYROMETALLURGY BEST PAPER AWARD

- **Ata Fallah-Mehrjardi**  
Senior Manager  
Aurubis AG
- **Taufiq Hidayat**  
University of Queensland
- **Peter Hayes**  
Professor and Program  
Leader  
University of Queensland
- **Evgueni Jak**  
Professor  
University of Queensland

## EPD NAGY EL-KADDAH AWARD FOR BEST PAPER IN MHD IN MATERIAL PROCESSING

- **Lukas Dion**  
Research Scientist  
Rio Tinto
- **Laszlo Kiss**  
Professor  
University of Quebec at Chicoutimi
- **Sandor Poncsak**  
Research Professor  
University of Quebec at  
Chicoutimi
- **Charles-Luc Lagace**  
Lean Expert  
Masonite International

## EPD MATERIALS CHARACTERIZATION AWARDS

### Best Paper Award – First Place

- **Mingming Zhang**  
Lead Research Engineer  
ArcelorMittal Global R&D
- **Udaya Bhaskar Kodukula**  
Lead Engineer  
ArcelorMittal Global R&D
- **Marcelo Andrade**  
Ironmaking Manager  
ArcelorMittal Global R&D

### Best Paper Award – Second Place

- **Zheng Wei**  
Chongqing University
- **Tao Li**  
Chongqing University
- **Xueli Cao**  
Fujian Institute of Research  
on the Structure
- **Hanying Wen**  
Chongqing University

- **Guodong Shi**  
Chongqing University
- **Lei Yu**  
Chongqing University
- **Lin Zhu**  
Chongqing University
- **Wen-xin Tang**  
Chongqing University
- **Meng Li**  
Chongqing University
- **Chenguang Bai**  
Chongqing University

### Best Poster Award – First Place

- **Mustafacan Kutsal**  
Student  
Technical University of  
Denmark
- **Bengisu Yasar**  
Research Assistant  
Middle East Technical  
University
- **Yunus Eren Kalay**  
Research Assistant  
Middle East Technical  
University

### Best Poster Award – Second Place

- **Veeraraghavan Sundar**  
Technical Marketing  
Manager  
UES Inc.
- **Satya RNL Ganti**  
Research Scientist  
UES Inc.
- **Bryan Turner**  
Materials Engineer  
Materials Resources LLC

### Best Poster Award – Third Place

- **Md Ashraf Islam**
- **Md Abdul Kader**  
Student  
University of South Wales
- **Paul Hazell**
- **Juan Escobedo Diaz**  
Lecturer-Assistant Professor  
University of South Wales
- **Andrew Brown**

#### FUNCTIONAL MATERIALS DIVISION (FMD)

## FMD JOHN BARDEEN AWARD

- **Eric Chason**  
Professor  
Brown University

## FMD DISTINGUISHED SERVICE AWARD

- **Tae-Kyu Lee**  
Associate Professor  
Portland State University

#### LIGHT METALS DIVISION (LMD)

## LMD DISTINGUISHED SERVICE AWARD

- **Barry Sadler**  
Managing Director  
Net Carbon Consulting Pty  
Ltd

## LMD LIGHT METALS AWARD

- **Jean-Louis Achar**  
R&D Technician  
Constellium Technology  
Center
- **Fabio Taina**  
Metallurgy and Quality  
Manager  
Constellium Isoire
- **Pierre Le Brun**  
Technical Expert  
Constellium Technology  
Center
- **Pierre-Yves Menet**  
R&D Group Manager  
Constellium Technology  
Center

## LMD JOM BEST PAPER AWARD

- **Gregory Smith**  
Researcher  
Naval Research Laboratory
- **Sanjay Sampath**  
Distinguished Professor and  
Director  
Stoney Brook University

## LIGHT METALS SUBJECT AWARDS

### Alumina/Bauxite

- **Panagiotis Davris**  
Aluminium of Greece
- **Efthymios Balomenos**  
Senior Researcher/External  
Associate  
National Technical University  
of Athens/ Mytilineos S.A.
- **Dimitrios Panias**  
Professor  
National Technical University  
of Athens
- **Ioannis Paspaliaris**  
Professor  
National Technical University  
of Athens

## Aluminum Reduction Technology

- **Grant J. McIntosh**  
Principal Chemist/Research Fellow  
University of Auckland
- **Hasini Wijayarathne**  
Research Engineer  
University of Auckland
- **Gordon E. K. Agbenyegah**  
Ph.D. Candidate  
University of Auckland
- **Margaret M. Hyland**  
Vice-Provost Research  
Victoria University of Wellington
- **James B. Metson**  
Deputy Vice Chancellor of Research  
University of Auckland

## Electrode Technology for Aluminum Production

- **Bruno Rausch**  
Principal Engineer  
Hydro Aluminium  
Deutschland GmbH
- **Juraj Chmelar**  
Area Manager Process  
Hydro Aluminium AS
- **Hogne Linga**  
Consultant
- **Lorentz Petter Lossius**  
Principal Engineer  
Hydro Aluminium AS
- **Rebecca J. Thorne**  
Researcher  
Institute of Transport Economics
- **Viktorija Tomkute**  
Project Engineer  
Hydro Aluminium AS

## Aluminum Alloys

- **Tao Liu**  
Graduate Research Assistant  
University of Alabama
- **Sydney Morales**  
Student  
University of Alabama
- **Mikko Karkkainen**  
Student  
University of Alabama
- **Luke N. Brewer**  
Associate Professor  
University of Alabama
- **Laurentiu Nastac**  
Professor  
University of Alabama
- **Vishweshwar Arvikar**  
Senior Process Engineer  
Nemak Alabama

- **Ilya Levin**  
Site Metallurgist  
Nemak Alabama

## LMD MAGNESIUM TECHNOLOGY AWARDS

### Application

- **Raymond Decker**  
Chief Technical Officer  
Thixomat/nanoMAG, LLC
- **Stephen LeBeau**  
President  
nanoMAG, LLC
- **Daniel LaCroix**  
Student  
Michigan Technological University
- **Surendra Makineni**  
Postdoctoral Research Fellow  
Max Planck Institute for Iron Research
- **John Allison**  
Professor  
The University of Michigan

### Fundamental Research

- **Huimin Lu**  
Professor  
Beihang University
- **Guangzhi Wu**  
Chairman  
Inner Mongolia Xintai Construction and Installation Group Co., Ltd

### Student Paper

- **Charlotte Wong**  
Student  
RMIT University
- **Mark J. Styles**  
Research Scientist  
CSIRO Manufacturing
- **Suming Zhu**  
Senior Research Fellow  
RMIT University
- **Trevor Abbott**  
Director - Research & Development  
Magontec Limited
- **Kazuhiro Nogita**  
Professor  
University of Queensland
- **Stuart D. McDonald**  
Senior Research Fellow  
University of Queensland
- **David StJohn**  
Professor Emeritas  
University of Queensland
- **Mark A. Gibson**  
Honorary Fellow  
CSIRO Manufacturing

- **Mark Easton**  
Professor  
RMIT University

### Best Poster

- **Zhihua Huang**  
Student  
University of Michigan
- **John Allison**  
Professor  
University of Michigan
- **Amit Misra**  
Professor  
University of Michigan

## LMD/EPD SUBJECT AWARDS

### Recycling

- **Jan Steglich**  
Project Manager R&D  
TRIMET Aluminium SE
- **Christiane Matthies**  
TRIMET Aluminium SE
- **Marcel Rosefort**  
Head of R&D  
TRIMET Aluminium SE
- **Bernd Friedrich**  
RWTH Aachen University
- **Thomas Boundy**  
Student  
Colorado School of Mines
- **Patrick Taylor**  
Professor  
Colorado School of Mines

### Energy Best Paper Awards

#### Professional:

- **Xia Lou**  
Professor  
Curtin University
- **Hossein Dashti**  
Ph.D. Candidate  
Curtin University

#### Student:

- **Mengqi Wei**  
Student  
Jiangsu Provincial Academy of Environmental Science
- **Qingbo Yu**  
Professor  
Northeastern University
- **Qiang Guo**  
University of Waterloo
- **Zongliang Zuo**  
Student  
Northeastern University
- **Qin Qin**  
Vice-Professor  
Northeastern University

## MATERIALS PROCESSING & MANUFACTURING DIVISION (MPMD)

### MPMD DISTINGUISHED SCIENTIST/ENGINEER AWARD

- **David Furrer**  
Senior Fellow  
Pratt & Whitney

## STRUCTURAL MATERIALS DIVISION (SMD)

### SMD DISTINGUISHED SCIENTIST/ENGINEER AWARD

- **Ricardo Lebensohn**  
Scientist 5  
Los Alamos National Laboratory

### SMD JOM BEST PAPER AWARD

- **Jeromy Snel**  
Business Development Manager  
LEITAT Technological Center
- **Miguel Alberto Monclus**  
Research Associate  
IMDEA Materials Institute
- **Miguel Castillo-Rodriguez**  
Instrument Scientist  
IMDEA Materials Institute
- **Nathan Mara**  
Associate Professor  
University of Minnesota
- **Irene J. Beyerlein**  
Professor  
University of California, Santa Barbara
- **Javier Llorca**  
Professor  
IMDEA Materials Institute
- **Jon Molina-Aldareguia**  
Senior Researcher  
IMDEA Materials Institute

## YOUNG PROFESSIONAL AWARDS

### EPD YOUNG LEADERS PROFESSIONAL DEVELOPMENT

- **Neslihan Dogan**  
Assistant Professor  
McMaster University

- **Leili Tafaghodi**  
Assistant Professor  
University of British  
Columbia

## FMD YOUNG LEADERS PROFESSIONAL DEVELOPMENT

- **Surojit Gupta**  
Associate Professor  
University of North Dakota
- **Ning Zhang**  
Research Assistant  
Professor  
Colorado School of Mines

## LMD YOUNG LEADERS PROFESSIONAL DEVELOPMENT

- **Kristian Etienne Einarsrud**  
Associate Professor  
Norwegian University of  
Science and Technology
- **Samuel Wagstaff**  
Process Scientist  
Novelis Inc

## MPMD YOUNG LEADERS PROFESSIONAL DEVELOPMENT

- **Oliver Johnson**  
Assistant Professor  
Brigham Young University
- **Srikanth Patala**  
Assistant Professor  
North Carolina State  
University

## SMD YOUNG LEADERS PROFESSIONAL DEVELOPMENT

- **Andrew Baker**  
Materials & Process  
Engineer  
Boeing
- **Lily Nguyen**  
Research Associate  
Naval Research Laboratory

## TMS/JIM YOUNG LEADERS INTERNATIONAL SCHOLAR

- **Fadi Abdeljawad**  
Assistant Professor  
Clemson University

## TMS/FEMS YOUNG LEADERS INTERNATIONAL SCHOLAR

- **Jennifer Carter**  
Assistant Professor  
Case Western Reserve  
University

## JIM YOUNG LEADERS INTERNATIONAL SCHOLAR

- **Sakiko Kawanishi**  
Assistant Professor  
Tohoku University

## STUDENT AWARDS

### EPD SCHOLARSHIP

- **Brooklyn Carlson**  
Student  
University of Wisconsin

### FMD GILBERT CHIN SCHOLARSHIP

- **Justin Qian**  
Student  
University of Pennsylvania

### LMD SCHOLARSHIP

- **Tanner Livingston**  
Student  
University of Utah

### MPMD SCHOLARSHIP

- **Mackenzie Keefer**  
Student  
Michigan Technological  
University
- **Matthew Thomas**  
Student  
Michigan Technological  
University

### KAUFMAN CALPHAD SCHOLARSHIP

- **Katelyn Adkison**  
Student  
Pennsylvania State  
University

## TMS INTERNATIONAL SYMPOSIUM ON SUPERALLOYS SCHOLARSHIP

- **Adam Ladd**  
Student  
University of Illinois
- **Hari Krishnan Rajendran**  
Student  
Texas A&M University

## TMS BEST PAPER CONTEST GRADUATE

### First Place:

- **Pranjal Nautiyal**  
Student  
Florida International  
University

### Second Place:

- **Rui Feng**  
Student  
University of Tennessee,  
Knoxville



**SAVE THE DATE!**

THE WORLD COMES HERE

# TMS 2020

149<sup>th</sup> Annual Meeting & Exhibition

**February 23-27, 2020**

San Diego, California, USA  
**#TMSAnnualMeeting**



**CO-LOCATED  
INTERNATIONAL CONFERENCE**

Considered the leading international technical forum for the lead and zinc processing Industries, PbZN 2020 programming is open to all TMS2020 attendees as part of their registration.

## **FOUR FULL DAYS OF HIGH-VALUE PROGRAMMING**

Don't miss a minute! TMS2020 officially kicks off on Sunday, March 10 with a full slate of learning and networking opportunities. Programming and events continue through Thursday, March 14.

For information and to sign up for updates, visit:  
[www.tms.org/TMS2020](http://www.tms.org/TMS2020)

**SEE YOU IN SAN DIEGO!**

## **IMPORTANT DATES**

**Call for Abstracts Opens:  
MAY 2019**

**Registration Opens:  
OCTOBER 2019**

**Exhibition Reservations  
NOW OPEN!  
Book Your Space Today**





## 2018-2019 TMS BOARD OF DIRECTORS

### OFFICERS

#### 2018 TMS President

**Kevin J. Hemker**

Professor and Chair, Johns Hopkins University

#### 2018 Vice President/Incoming 2019 President

**James C. Foley**

Sigma-1 Group Leader, Los Alamos National Laboratory

#### Incoming 2019 Vice President

**Thomas Battle**

Extractive Metallurgy Consultant

#### Past President

**David H. DeYoung**

Director of R&D, Breakthrough Technology, Alcoa Technical Center

#### Financial Planning Officer

**Adrian C. Deneys**

Business Development Manager, Praxair Inc.

#### Secretary (non-voting)

**James J. Robinson**

Executive Director, TMS

### FUNCTIONAL AREA DIRECTORS

#### Membership & Student Development

**Amy J. Clarke**

Associate Professor, Colorado School of Mines

#### Incoming Membership & Student Development

**Alexis C. Lewis**

Program Director, National Science Foundation

#### Programming

**Brad L. Boyce**

Senior Member for the Technical Staff, Sandia National Laboratories

#### Professional Development

**Chester J. Van Tyne**

Professor Emeritus, Colorado School of Mines

#### Content Development & Dissemination

**Michele V. Manuel**

Professor, University of Florida

#### Public & Governmental Affairs

**John A. Howarter**

Assistant Professor, Purdue University

### TECHNICAL DIVISION DIRECTORS

#### Extraction & Processing Division

**Cynthia K. Belt**

Energy Management Consultant, Metals Energy Management LLC

#### Functional Materials Division

**Raymundo Arróyave**

Professor, Texas A&M University

#### Light Metals Division

**Alan A. Luo**

Professor and Director, The Ohio State University

#### Incoming Light Metals Division

**Eric Nyberg**

#### Materials Processing & Manufacturing Division

**Corbett C. Battaile**

Principal Member, Technical Staff, Sandia National Laboratories

#### Incoming Materials Processing & Manufacturing Division

**Mark R. Stoudt**

Materials Research Engineer, National Institute of Standards and Technology

#### Structural Materials Division

**Ellen K. Cerreta**

Deputy Division Leader, Los Alamos National Laboratory

#### Incoming Structural Materials Division

**Daniel Miracle**

Senior Scientist, Air Force Research Laboratory

# TMS UPCOMING MEETINGS

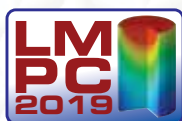
For a complete listing of TMS meetings, visit: [www.tms.org/Meetings](http://www.tms.org/Meetings)



**5th World Congress on Integrated Computational Materials Engineering**  
July 21-25, 2019 • Indianapolis, Indiana, USA  
[www.tms.org/ICME2019](http://www.tms.org/ICME2019)



**11th International Conference on Porous Metals and Metallic Foams**  
August 20-23, 2019 • Dearborn, Michigan, USA  
[www.tms.org/MetFoam2019](http://www.tms.org/MetFoam2019)



**2019 Liquid Metal Processing & Casting Conference**  
September 8-11, 2019 • Birmingham, UK  
[www.tms.org/LMPC2019](http://www.tms.org/LMPC2019)



**Materials Science & Technology 2019 Technical Meeting and Exhibition**  
September 29-October 3, 2019 • Portland, Oregon, USA  
[www.matscitech.org](http://www.matscitech.org)



**World Congress on High Entropy Alloys**  
November 17-20, 2019 • Seattle, Washington, USA  
[www.tms.org/HEA2019](http://www.tms.org/HEA2019)



**Congress on Safety in Engineering and Industry**  
June 21-24, 2020 • Philadelphia, Pennsylvania, USA  
[www.safetycongress.org](http://www.safetycongress.org)



**The 13th International Conference on the Technology of Plasticity**  
July 26-31, 2020 • Columbus, Ohio, USA  
[www.tms.org/ICTP2020](http://www.tms.org/ICTP2020)



**The 14th International Symposium on Superalloys**  
September 13-17, 2020 • Seven Springs, Pennsylvania, USA  
[www.tms.org/Superalloys2020](http://www.tms.org/Superalloys2020)



**TMS 2020 Annual Meeting & Exhibition**  
February 23-27, 2020 • San Diego, California, USA  
[www.tms.org/TMS2020](http://www.tms.org/TMS2020)

## An integrated platform for materials design and development

Please visit our booth # 207 for more information

### Pandat™ Software

- ◆ **PanPhaseDiagram** for calculating multi-component multi-phase thermodynamic properties and phase equilibria
- ◆ **PanPrecipitation** for simulating precipitation kinetics of multi-component alloys during heat treatment processes
- ◆ **PanDiffusion** for modeling diffusion-controlled phase transformations in multi-component systems
- ◆ **PanOptimizer** for optimizing thermodynamic model parameters and thermophysical properties

### PanEngine API

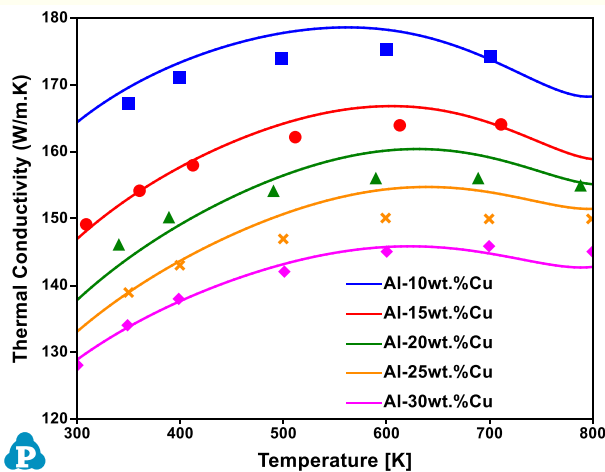
- ◆ Dynamic-linked library of thermodynamic functions and phase equilibria that can be integrated with user's in-house code

### Databases

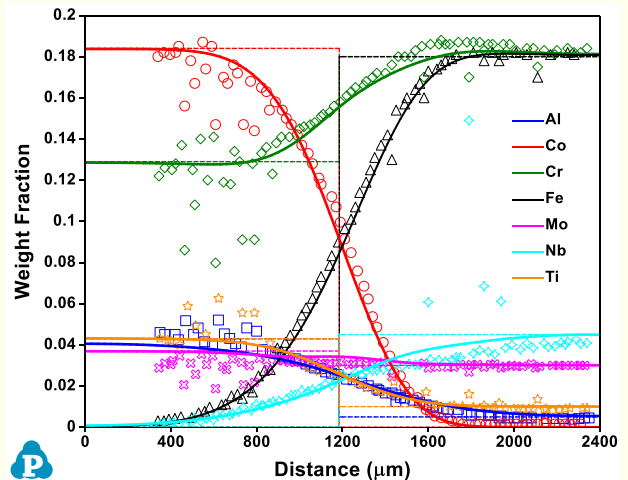
- ◆ Thermodynamic, atomic mobility, and molar volume databases for variety of multi-component alloy systems

### Consultation

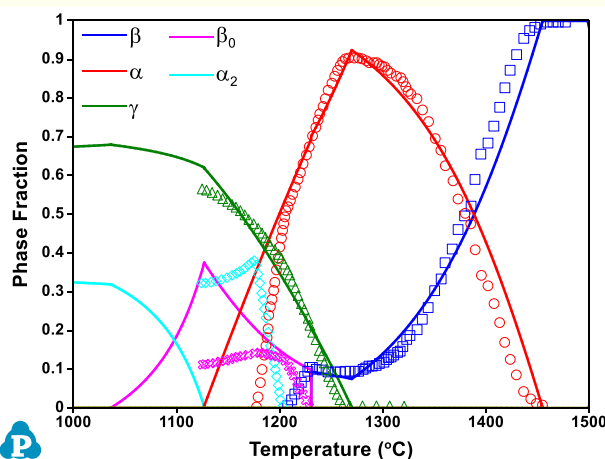
- ◆ Provide materials solutions on multi-component phase equilibria, diffusion, precipitation, weldability, castability etc.
- ◆ Develop customized thermodynamic databases, mobility databases and thermophysical property databases and more
- ◆ Support software integration with PanEngine API to obtain instant thermodynamic input for custom applications



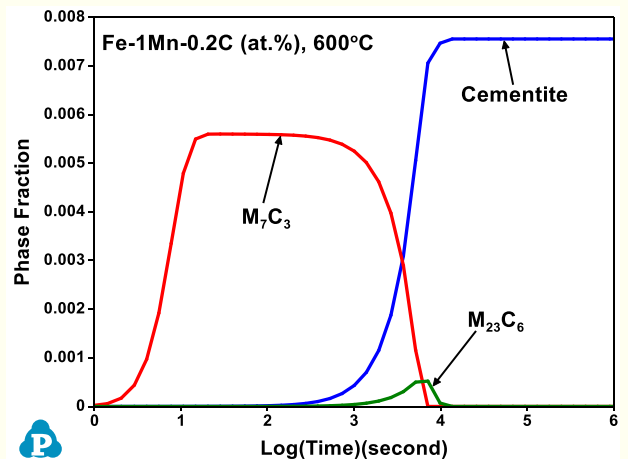
Calculated thermal conductivities of Al-Cu alloys located in the (Al)+ $\theta$  region with experimental data



Diffusion simulation between IN100 and Alloy718 at 1150°C for 1000 hours with experimental data



Phase fraction vs. temperature for TNM (Ti-43Al-4Nb-1Mo-0.1B at.%) alloy with experimental data



Precipitation simulation of Fe-1Mn-0.2C (at.%) alloy heat-treated at 600°C



palladium catalysts thin film nickel foam  
 nanogels glassy carbon buckyballs  
 europium phosphors diamond micropowder

alternative energy additive manufacturing III-IV semiconductors CIGS  
 surface functionalized nanoparticles organometallics gallium lump ITO  
 zeolites 99.99% ruthenium spheres copper nanorods  
 anode nanodispersions 3D graphene foam Nd:YAG  
 osmium  
 MOFs  
 ZnS  
 AuNPs epitaxial crystal growth macromolecules silver nanoparticles Invar  
 EuFOD  
 quantum dots GDC  
 transparent ceramics rhodium sponge nanodispersions chalcogenides  
 refractory metals cerium oxide polishing powder rare earth metals spintronics  
 mesoporous silica sputtering targets  
 MBE OLED lighting laser crystals calcium wires platinum ink YBCO  
 tungsten carbide photovoltaics  
 praseodymium pellets metamaterials  
 lithium niobate superconductors  
 graphene oxide ultra high purity materials optical glass solar energy

1 H 1.00794 Hydrogen	2 He 4.002602 Helium																
3 Li 6.941 Lithium	4 Be 9.012182 Beryllium											5 B 10.811 Boron	6 C 12.0107 Carbon	7 N 14.0067 Nitrogen	8 O 15.9994 Oxygen	9 F 18.9984032 Fluorine	10 Ne 20.1797 Neon
11 Na 22.98976928 Sodium	12 Mg 24.305 Magnesium											13 Al 26.9815386 Aluminum	14 Si 28.0855 Silicon	15 P 30.973762 Phosphorus	16 S 32.065 Sulfur	17 Cl 35.453 Chlorine	18 Ar 39.948 Argon
19 K 39.0983 Potassium	20 Ca 40.078 Calcium	21 Sc 44.955912 Scandium	22 Ti 47.867 Titanium	23 V 50.9415 Vanadium	24 Cr 51.9961 Chromium	25 Mn 54.938045 Manganese	26 Fe 55.845 Iron	27 Co 58.933195 Cobalt	28 Ni 58.6934 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.64 Germanium	33 As 74.9216 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
37 Rb 85.4678 Rubidium	38 Sr 87.62 Strontium	39 Y 88.90585 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.90638 Niobium	42 Mo 95.96 Molybdenum	43 Tc 98.0 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.9055 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.8682 Silver	48 Cd 112.411 Cadmium	49 In 114.818 Indium	50 Sn 118.71 Tin	51 Sb 121.76 Antimony	52 Te 127.6 Tellurium	53 I 126.90447 Iodine	54 Xe 131.293 Xenon
55 Cs 132.9054 Cesium	56 Ba 137.327 Barium	57 La 138.90547 Lanthanum	58 Ce 140.12 Cerium	59 Pr 140.90766 Praseodymium	60 Nd 144.242 Neodymium	61 Pm 145 Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.92534 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.93033 Holmium	68 Er 167.259 Erbium	69 Tm 168.93421 Thulium	70 Yb 173.054 Ytterbium	71 Lu 174.967 Lutetium	
87 Fr 223 Francium	88 Ra 226 Radium	89 Ac 227 Actinium	90 Th 232.0377 Thorium	91 Pa 231.03688 Protactinium	92 U 238.02891 Uranium	93 Np 237 Neptunium	94 Pu 244 Plutonium	95 Am 243 Americium	96 Cm 247 Curium	97 Bk 247 Berkelium	98 Cf 251 Californium	99 Es 252 Einsteinium	100 Fm 257 Fermium	101 Md 259 Mendelevium	102 No 259 Nobelium	103 Lr 260 Lawrencium	

# Now Invent.™

The Next Generation of Material Science Catalogs

Over 15,000 certified high purity laboratory chemicals, metals, & advanced materials and a state-of-the-art Research Center. Printable GHS-compliant Safety Data Sheets. Thousands of new products. And much more. All on a secure multi-language "Mobile Responsive" platform.

**American Elements opens a world of possibilities so you can Now Invent!**

[www.americanelements.com](http://www.americanelements.com)