Meet a Member: Leon Prentice Leads "Supersonic" Advances in Magnesium Production

By Lynne Robinson

Editor's Note: Prentice will deliver the 2013 Vittorio de Nora Prize Lecture at the TMS 2013 Annual Meeting & Exhibition, March 3–7, in San Antonio, Texas. For details, go to the "Special Lectures" section of the Annual Meeting website at *http://www.tms.org/tms2013.*

Effectively deploying magnesium—the lightest of all structural metals—in the transportation industry could yield significant fuel and carbon reduction efficiencies. Ironically, these potential benefits are offset by the fact that traditional magnesium production methods are extremely energy-intensive and detrimental to the environment. Leon Prentice, senior research engineer, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Melbourne, Australia, is using the tools of "rocket science" to change that equation.

Prentice and his work on MagSonic™—a technology that enables magnesium production by carbothermal reduction—earned the 2013 Vittorio de Nora Prize for Environmental Improvements in Metallurgical Industries. At laboratory scale, the MagSonic process can potentially cut the energy consumption required for magnesium production by half and reduce its environmental impact by 85 percent. "I'm proud of the work that my team and I have put in over the last few years, and I think the environmental sustainability advantages of the MagSonic technology are evident. I'm hoping that those advantages can be realized in practice in the near future, as the technology is developed and scaled up to make a major impact in the industry," Prentice said. "It's also a profound honor to be selected for the prize, as I know many very able researchers and colleagues who are doing excellent work and making a difference in metallurgical industries."

MagSonic involves heating magnesia with carbon to above 1,700°C in an inert atmosphere to reduce the magnesium to a vapor and produce carbon monoxide. To prevent the magnesium from reverting back to magnesia, MagSonic uses a Laval nozzle—historically used in rocket engines for propulsion—to "shock quench" the gases. The gases are pulled through the nozzle at four to five times the speed of sound, causing them to cool in milliseconds and freezing the magnesium. The magnesium can then be separated from the carbon monoxide and recovered as a powder.

At the time Prentice joined the project in 2007, the team had successfully achieved supersonic quenching, but still faced several challenges. Of these, Prentice said, preventing the condensing magnesium and related impurities from forming a solid mass and blocking the nozzle was the most complex. That has since been resolved, with Prentice noting that the process can now operate indefinitely without experiencing a blockage. The team has also made great strides in recovering the magnesium powder. "We thought the particle size would be too small to effectively capture," said Prentice. "Not only can we capture the powder, we've also worked out a good way of re-melting and purifying it."

Prentice said that an aspect of the MagSonic project that he appreciates is "the inherent simplicity—almost elegance—of the carbothermal reaction, offset by its engineering challenges." He notes that he is also motivated "to find sustainable solutions to more global issues."

"I think process engineers, particularly those in research, are uniquely placed to make a significant difference in our world," he said. "We need to address the fundamental issues that are becoming more and more apparent—energy, water, climate, sustainability, food, and so on. I spent a large part of my childhood growing up in Africa, and I'm passionate about technologies that can make a difference for everyone."

Prentice said that winning the de Nora Prize marks a significant step in MagSonic's development. "I hope it raises the profile of what we do," he said, "in particular that we have the ability to pull together multi-disciplinary, specialized teams to work on challenging projects of national and global relevance."

Leon Prentice with the MagSonic™ laboratory-scale apparatus. Prentice will discuss the technology in his lecture, "It Is Rocket Science: the Engineering and Impact of Carbothermal Magnesium Technology" at the TMS 2013 Annual Meeting & Exhibition as the winner of the 2013 Vittorio de Nora Prize.

Each month, *JOM* profiles a TMS member and his or her activities both in and out of the realm of materials science and engineering. To suggest a candidate for this feature, contact Lynne Robinson at lrobinson@tms.org.