Dr. Sridhar Seetharaman
Completes the AIST 2011–2012
Elliott Lecture Series

Dr. Sridhar Seetharaman, POSCO Professor at Carnegie Mellon University, Pittsburgh, Pa., was the 2011–2012 AIST Elliott Lecturer. During the summer and fall of 2011, he presented his lecture, "Interfacing Chemical and Physical Metallurgy," at the Royal Institute of Technology (Sweden), Clemson University, Missouri University of Science & Technology, and The Illinois Institute of Technology. Dr. Seetharaman provided this summary of his lectureship.

The AIST John F. Elliott Lectureship was established in 1990. This honorary lectureship is designed to acquaint students and engineers with the exciting opportunities in chemical process metallurgy; inspire them to pursue careers in this field; inform the public of the contributions of chemical process metallurgy and materials chemistry to the association; and honor the late Prof. John Elliott of the Massachusetts Institute of Technology (MIT) for his many accomplishments and the leadership that he provided during his career. The recipient presents a lecture at three or more universities throughout the year following selection.

"During 2011–2012, I had the great pleasure to have been the AIST Elliott Lecturer and deliver seminars at various universities, with the motivation of encouraging students to pursue careers in process metallurgy. This was a particularly important honor for me. Ever since I was in high school, I had heard about Prof. John Elliott from my father, and how he was a giant in our field. By the time I finished my undergraduate degree, I knew, as any metallurgist would, of how Prof. Elliott contributed a vast wealth of knowledge to the field of physical chemistry of melts in areas such as thermodynamic measurements, slag metal reactions, etc. I went to Massachusetts Institute of Technology (MIT) largely due to the mythological status Prof. Elliott had in my mind. I had the fortune to work in the basement lab at the end of the famed 'infinite corridor,' and this very lab had, I found out, once belonged to Prof. Elliott. His notes on various apparatus were still there, and some of his class notes and textbooks were lying around in the various crevices of the labs. It was then that I appreciated that Prof. Elliot was also a great educator. I found classical texts and compilations, including *Thermochemistry of Steelmaking* and *Metallurgical Treatises*. I also found handwritten class notes, and it was clear that he was not only a great scientist, but also a passionate and dedicated instructor.

"I chose as a title of my seminar series, 'Interfacing Chemical and Physical Metallurgy,' because I feel it's an area of importance, both technologically and scientifically, with much room for development for new engineers and scientists. The field of physical metallurgy has historically involved the study of solid-state structures and their properties, using microscopy as the primary tool of investigation to resolve the many features of the structures at various size-scales. Chemical metallurgy, on the other hand, has largely focused on heterogeneous reactions involving at least one fluid phase. The tools involved have largely been indirect ones, i.e., to study results of the reactions through thermal analysis or gas analysis, for example. However, advances in the last decades have allowed scientists to

> "The Elliott Lecture given by Prof. Seetharaman was quite interesting, especially because it had a new approach toward the very old subject of steelmaking. This approach of connecting and combining different areas to study and observe seems to be very necessary and fruitful. The lecture was delivered in a striking yet comprehensible manner."
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> *— Babak Khalaghi, Ph.D. student, Department of Materials Science and Engineering, Royal Institute of Technology (KTH), Sweden*

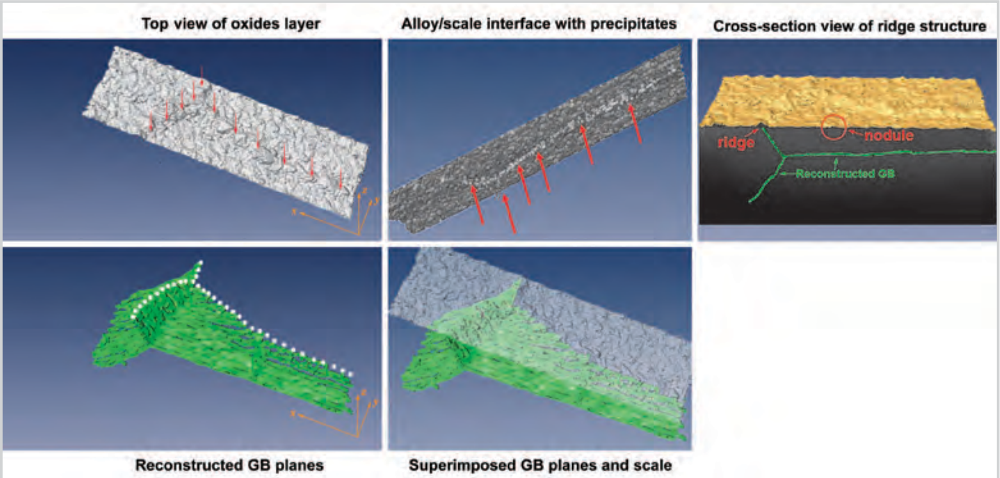

Figure 1 — The grain boundaries in a Fe-Cr alloy allow for fast transport of alloying elements. The FIB reconstruction in the top right image is shown in various parts in the other images. The oxide ridges shown on the top left image are caused by rapid Mn transport through the alloy grain boundaries, shown in the bottom left image.

Figure 2 — Dr. Seetharaman with the Material Advantage student chapter after his talk at Clemson University.

"The highest point of Dr. Seetharaman's presentation, for me, was the link he showed between grain boundary misorientation and the rates of surface oxidation in steels. His lecture was important to understanding the link between theoretical knowledge and industrial practice on steel defects. He delivered this with clear illustrations, mainly from his research findings and a step-by-step approach that made his talk easier to follow."

— Lucas Damoah, Ph.D. student, Department of Metallurgical Engineering, Missouri University of Science and Technology

apply tools that were traditionally those of physical metallurgists to study reactions at high temperatures in-situ. This includes high-temperature imaging through x-ray radioscopy, fluoroscopy or tomography, as well as confocal-scanning-laser microscopy. Reaction rates are often influenced by the structures on or through which they happen. Similarly, the results of chemical reactions and the rate at which they occur influence various structures.

"Thus, a host of interesting phenomena can be better understood through a closer coupling between the structural understanding gained through physical metallurgy and the reaction rates studied through chemical metallurgy. For example, in this era of limited raw material supply, alternative carbonaceous feedstock to cooking coal may gasify at rates depending on the microstructure of the starting material. Or, as another example, direct hot charging limits the use of thermomechanical processing and, therefore, the melt chemistry and inclusion evolution before and during continuous casting are used to influence the subsequent solid-state phase transformations. As a third example, during oxidation reactions of steel surfaces, selective surface oxidation may be influenced by the grain and grain boundary structure of the solid steel. An example of the last mentioned case is shown in Figure 1." ✦