Carnegie Mellon
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"On the Kinetics, Morphology, and Mechanism of Austenite Formation during Thermal Processing of Iron Alloys"

Friday, January 15, 2007
11:00 A.M. Seminar in Baker Hall 136A
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

Austenitization is an important step in steel heat-treating procedures, but has not received the more rigorous treatment that has been accorded to other solid-state phase transformations that occur during thermal processing. This is primarily due to the difficulty in observing the evolution of the austenitized microstructure, as it cannot be preserved at room temperature in many of the alloys. Indirect methods, such as dilatometry and calorimetry, can only provide rough kinetic measurements and do not provide any observations of individual migrating interfaces or evolving morphologies; the evaluation of quenched structures becomes impracticable as transformation kinetics become rapid. Thus, a necessary requirement of this project has been to develop a suitable paradigm by which to directly observe and analyze migrating interfaces during a high temperature solid-state phase change. A recently developed observation tool, hot-stage Confocal Scanning Laser Microscopy (CSLM), has been of great importance in achieving this goal. Austenite/ferrite interfaces have been observed in a range of alloys, starting with pure iron and increasing in complexity. Experimental alloys have been chosen carefully in order to examine the possible kinetic models for a migrating interface, e.g. long-range diffusion and the interface reaction, and a rate-controlling mechanism or set of mechanisms has been proposed in each case. Direct measurement capabilities provided by the CSLM have allowed the analysis of interface migration kinetics during a regime where the thermodynamic driving force and diffusion mass transfer rate are increasing concurrently, in contrast to the widely studied austenite decomposition reaction. The behavior of interfaces while in this regime, when the migration rates seem to transition from long-range diffusion to interface reaction control, is a primary focus of this project.

Eric received his Bachelor degree in Materials Science and Engineering from Carnegie Mellon University in 2004. He is currently a Ph.D. candidate under the guidance of Prof. Sridhar Seetharaman.