

# Carnegie Mellon University

## Materials Science & Engineering

presents

### Process Metallurgy of 21<sup>st</sup> Century Steel: State-of-the-Art and Emerging Challenges

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#### **ABSTRACT:**

Since the dawn of the Iron Age, ironmaking and steelmaking processes have been highly demanding of energy and have involved the intensive consumption of carbon. Today, steel is a vital requirement of industrial economies and worldwide steel production is greater than 1.7 billion tons/year. Over the last 100 years, improvements in process methods and efficiencies have greatly reduced energy and carbon consumptions and reduced CO<sub>2</sub> emissions. However, modern iron and steelmaking processes continue to make extensive use of carbon from fossil sources to serve as fuel and reducing agent for the liberation of Fe from iron oxide. Although newly-developed ultra-high-strength steels (with strengths reaching above 10<sup>9</sup> Pascal) will be helpful in maintaining steel's prominence in the spectrum of modern industrial materials, major reductions in energy consumption and CO<sub>2</sub> emissions will be essential and very likely mandatory to the continued success of the steel industry in the 21<sup>st</sup> century. Much research and development is currently ongoing that concentrates on the application of CO<sub>2</sub> capture and storage (CCS) methods to iron and steelmaking processes. Emerging technologies and recent advancements in the process metallurgy of iron and steelmaking that do not involve CCS are the focus of this lecture, with emphasis on their potential to reduce energy and carbon consumptions. The opportunities for the replacement of carbon in the form of coals and cokes by natural gas, electric power, and/or hydrogen in iron and steelmaking processes and the implementation of emerging cast/rolling processes that continuously convert liquid steel to a finished product are examined.

#### **BIOGRAPHY:**

L. J. (Larry) Heaslip received his PhD in Metallurgy and Materials Science from the University of Toronto in 1981. Early in his career, Dr. Heaslip taught metallurgical process engineering at his alma mater, and lectured on the continuous casting of steel at the University of Michigan Center for Professional Development. He is named as an inventor on more than 20 patents granted in the U.S. Patent Office and on many more patents worldwide. He has lectured for more than 20 years at the annual Practical Training Seminar in Electric Arc Furnace Steelmaking, an AIST (Assoc. for Iron & Steel Technology) short-course, which has provided instruction to more than 2500 steel industry and steel supplier professionals since its inception in 1995. In 2014, Larry was presented with AIST's 'John Bell Award for Electric Arc Furnace Innovation, Improvement and Education', in 2015 he was presented with the 'AIME Benjamin F. Fairless Award for Distinguished Achievement in Iron and Steel Production and Ferrous Metallurgy', in 2019 he received the 'John F. Elliot Lectureship' from the AIST and the 'Billy Wallace Award' from the Electric Metal Makers Guild. Currently, Dr. Heaslip serves as a Director of *Interflow Techserv Inc.*, a company developing modern solutions that accelerate technological advancements in liquid steel processing for today's innovative steel producers.

**Doherty Hall 2210, 11:30AM  
Friday, October 11, 2019**