“CFD Modeling and Simulation in Materials Processing” Symposium

Foreword

The “CFD Modeling and Simulation in Materials Processing” symposium was sponsored by the Association for Iron and Steel Technology, the Process Technology and Modeling Committee of the Extraction and Processing Division and the Solidification Committee of the Materials Processing and Manufacturing Division of TMS (The Minerals, Metals & Materials Society) as part of the TMS 2012 Annual Meeting & Exhibition held in Orlando, FL, USA, from March 11 to 15, 2012. The objective of this symposium was to bring together experienced scientists and engineers that are involved in the CFD modeling of multiscale and multiphase phenomena in material processing systems. The organizers of the symposium were Laurentiu Nastac, Lifeng Zhang, Brian G. Thomas, Adrian Sabau, Nagy El-Kaddah, Adam C. Powell, and Hervé Combeau.

Computational fluid dynamics (CFD) is a sophisticated method that uses mathematical equations and computer algorithms to simulate fluid flow, heat and mass transfer, and other related phenomena in a defined system. CFD modeling and simulation tools can successfully be tailored to capture multiscale and multiphase phenomena in complex material processing systems. Recently, CFD modeling and simulation technology has grown significantly in the manufacturing sector as often being the only efficient way to design, analyze, and optimize complex manufacturing processes. I anticipate that more CFD tools will be implemented in the near future by industries related to materials processing to solve complex multiscale and multiphase engineering problems.

The symposium’s main focus was CFD modeling and simulation of multiscale and multiphase phenomena in material processing systems. The symposium also covered essential applications of CFD to engineering processes and demonstrated how CFD can help scientists and engineers better understand the fundamentals of engineering processes.

This special issue of the *Metallurgical and Materials Transactions B* journal contains some of the best papers presented at this CFD symposium. These papers cover several distinctive aspects related to CFD modeling and simulation of highly complex metallurgical processes, including the following:

1. Interaction of compressible oxygen jets with a free surface during the basic oxygen furnace (BOF) steel-making processing.
2. Simulation of the mechanisms of transport, aggregation, flotation, and surface entrapment of inclusions during the gas-stirring ladle treatment of liquid metal by coupling the CFD and the population balance equation (PBE) computations.
3. Turbulence, transport, and entrapment of inclusions and bubbles simulated via a Lagrangian technique as well as the impact of soft reduction during continuous casting of steel products.
4. Multiple flow phenomena and multiscale aspects during casting of large ingots including flow-induced columnar-to-equiaxed transition and three-dimensional (3-D) formation of channel segregates.
5. Melt flow and solidification of thin but large centrifugally cast products.
6. Multiphase magnetohydrodynamics (MHD) phenomena during the electroslag remelting (ESR) process.
7. Mesoscale fully transient predictions of the ingot solidification structure and solidification-related defects commonly occurring during the vacuum arc remelting (VAR) process of IN718 ingots.
8. Modeling of the processing effects on the solidification and macrosegregation phenomena during VAR process of Zircaloy 4 ingots.

I really hope that the papers published in this special issue of *Metallurgical and Materials Transactions B* and the ensuing discussions held during the conference will continue to advance our understanding of various multiscale–multiphase–multicomponent phenomena occurring in materials processing systems and further promote the application of CFD models to solve complex engineering problems.

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