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# 学术报告会

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# Advanced process control and analysis of Czochralski and Bridgman crystal growth method


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## Abstract:

This lecture overviews the progress made in the area of metal casting, annealing and crystal growth processes involving phase transition and deformations during material treatment. The prime examples of such processes are given by the Czochralski and Bridgman melt-crystal growth processes. In the Czochralski crystal growth process a solid crystal seed is pulled out of the melt, while tight control of temperature environment is responsible for the growth process rate, the shape and quality of a grown crystal. In the Bridgman process, the crystal is loaded into an ampoule, melted and resolidified by varying the temperature field and translating the ampoule through the furnace. The change of crystal shape during the crystal growth process induces the time-varying system description. Through a selected example of the Czochralski crystal growth process, the evolution system representation of convection-diffusion-reaction type processes involving deformations characterized by a time-dependent change in the material domain boundary will be described. In the second part of the talk, focus will shift towards the aspects related to the melt mixing in the crystal growth processes. In particular, a dynamical analysis of the melt flow features described by the detailed finite element model (FEM) reveals the mixing templates in the CZ and vertical Brigman process through identification of transport barriers (Langrangian Coherent Structures). The issue of non-uniform distribution of impurities in the grown crystal is linked to the presence of material lines which separate flow in the region close to the melt-solid crystal interface and provides a novel insight in the features of the melt-crystal growth processes.


## Biography:

**Stevan S. Dubljevic** is an assistant professor at the Chemical and Materials Engineering Department at the University of Alberta. He received his Ph.D. in 2005 from the Henry Samueli School of Engineering and Applied Science at University of California in Los Angeles (UCLA), M.S. degree (2001) from the Texas A&M University (Texas), and the B.Sc. degree (1997) from the Belgrade University (Serbia). He held independent post-doctoral researcher position at the Cardiology Division of the UCLA's David Geffen School of Medicine (2006-2009). He is the recipient of the American Heart Association (AHA) Western States Affiliate Post-doctoral Grant Award (2007-2009) and the recipient of the O. Hugo Schuck Award for Applications, from American Automatic Control Council (AACC) 2007. His research interests include systems engineering, with the emphasis on model predictive control of distributed parameter systems, dynamics and optimization of materials manufacturing (crystal growth) and chemical process operations, computational modelling and simulation of biological systems (cardiac electrophysiological systems) and biomedical engineering. He is the reviewer for the IEEE Transaction on Automatic Control, IEEE Transaction on Control Systems Technology, Automatica, Industrial & Engineering Chemical Research, International Journal of System Science, American Control Conference, Conference on Decision and Control, and program coordinator for the AIChE Annual Meetings (2014).