Te Tari Pūhanga Pūrere|Mechanical Engineering Department

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2 pm
John Britten 102 Conference Foyer

Modeling of Flash Sintering of Ionic Ceramics: From Individual Defects to the Engineering Level

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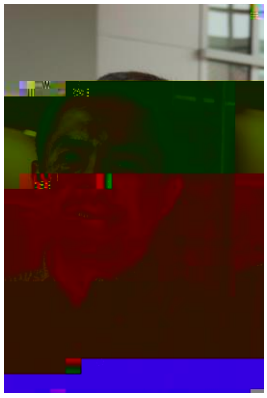
Abstract: The properties of semiconducting and ionic solids enable the development of a wide variety of applications that range from sensors and actuators to structural materials, and from energy capture and conversion to storage technologies. For all these applications, a wide variety of processing routes exist to consolidate an initial granular powder that will be later used as a starting point for the fabrication of carefully thought out layers and multifunctional architectures. Sintering of ceramics, in particular, is a processing methodology that is a result of the underlying contributions from individual point (vacancies and interstitials) line defects (dislocations), and surfaces and interfaces, as they interact in a local microstructural, mechanical, chemical, and electrical field induced through local or external stimuli.

In this presentation, by starting from fundamental thermodynamic concepts, a generalized phase field theory is presented to describe the chemical and electric field-induced mechanisms that control the flash sintering of ceramics. Well known aging phenomena observed in metals, such as the Cottrell effect and the Portevin-Le Chatelier effect, are revisited in the context of the underlying ionic character of ceramics. The impact of these mechanisms at the particle level are assessed, and its coupling to the macroscopic sintering curves are discussed and quantified. Applications to Y2O3, 3YSZ, TiO2, and Al2O3 will be presented.



Bio Sketch: R. Edwin García is a Professor at the School of Materials Engineering at Purdue University, in West Lafayette, Indiana. He received his undergraduate degree in Physics from the Universidad Nacional Autónoma de México (1996), and both his MS (2000) and PhD in Materials Science and Engineering (2003) from the Massachusetts Institute of Technology. He conducted postdoctoral work at the National Institute of Standards and Technology (2003-2005). Edwin joined Purdue University in 2005 as an Assistant Professor, and was promoted to Associate (2011) and then Full Professor (2015). His research group focuses on the development of theories, models, and algorithms to design materials and devices. The aim is to provide principles and guidelines that will lead to experiments and processing operations with improved properties, performance, and reliability. Current efforts include the modeling and simulation of rechargeable batteries, electric field assisted sintering, and data analytics of thermodynamic and kinetic properties.

All are welcome!