

Fall 11-9-2015

# Nanostructured metal-ceramic composites by internal reduction

Ivar Reimanis

*Colorado School of Mines*, ireimani@mines.edu

Amy Morrissey

*Colorado School of Mines*

Follow this and additional works at: [http://dc.engconfintl.org/composites\\_all](http://dc.engconfintl.org/composites_all)



Part of the [Materials Science and Engineering Commons](#)

---

## Recommended Citation

Ivar Reimanis and Amy Morrissey, "Nanostructured metal-ceramic composites by internal reduction" in "Composites at Lake Louise (CALL 2015)", Dr. Jim Smay, Oklahoma State University, USA Eds, ECI Symposium Series, (2016). [http://dc.engconfintl.org/composites\\_all/26](http://dc.engconfintl.org/composites_all/26)

This Conference Proceeding is brought to you for free and open access by the Proceedings at ECI Digital Archives. It has been accepted for inclusion in Composites at Lake Louise (CALL 2015) by an authorized administrator of ECI Digital Archives. For more information, please contact [franco@bepress.com](mailto:franco@bepress.com).

## **NANOSTRUCTURED METAL-CERAMIC COMPOSITES BY INTERNAL REDUCTION**

Ivar Reimanis and Amy Morrissey  
Colorado School of Mines  
Golden, CO 80401  
USA  
ireimani@mines.edu

The nucleation and growth of metallic particles within metal-doped oxides exposed to reducing conditions is relevant to the processing of materials for catalysts, fuel cells, and structural applications. Here, the precipitation of metallic nickel during the internal reduction of nickel-doped yttria stabilized zirconia (YSZ) is studied with electron microscopy and SQUID magnetometry. It is shown that the microstructure evolution proceeds in three distinct stages, each with its own kinetics description, dependent on the porosity and grain size. The transitions between stages depend on concentration gradients and electrostatic potentials that act upon the relevant transporting species, namely oxygen vacancies, electrons, nickel ions and zirconium vacancies. An understanding of these mechanisms enables the design of specific nanostructures.

### **Reimanis Bio**

Ivar Reimanis currently serves as interim Department Head for the Metallurgical and Materials Engineering Department at Colorado School of Mines in Golden, Colorado. He holds the Hermann F. Coors Distinguished Chair of Ceramic Engineering at Mines. Ivar earned his PhD at the University of California at Santa Barbara working under Tony Evans. He did postdocs at the Max-Planck Institute in Stuttgart and Los Alamos National Laboratory and was a staff member at Los Alamos, before joining Mines in 1994.