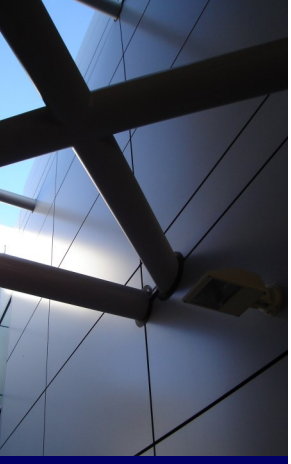

MECHANICAL ENGINEERING

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of

Corey Hardin

Friday, December 5, 2014, 3PM
in Bourns Hall A265

CAPAD processing of Rare Earth Doped Zirconia for High Temperature Light Emission Applications

Doctor of Philosophy, Graduate Program in Mechanical Engineering
University of California, Riverside, December 2014
Dr. Javier Garay, Chairperson

The high fracture toughness of stabilized zirconia makes it one of the most widely applicable high temperature structural materials. However, it is not typicality considered for optical applications since the microstructure achieved by traditional processing makes it opaque. The aim of this dissertation is to develop processing methods for the introducing new functionalities of light transparency and light emission (photoluminescence) and to understand the nanostructure-property relationships that make these functionalities possible. A processing study of rare-earth (RE) doped Zirconium Oxide (ZrO2, zirconia) via Current Activated Pressure Assisted Densification (CAPAD) is presented. The role of processing temperature and dopant concentration on the crystal structure, microstructure and properties of the RE: ZrO2 is studied. Microstructural shows sub-100 nm grain size and homogeneous dopant distribution. X-ray diffraction and Raman analysis show that with increased dopant concentration the material changes from monoclinic to tetragonal. Structural analysis shows the material shows high hardness and toughness values 30% greater than similarly processed yttria-stabilized zirconia. Despite birefringence in the tetragonal phase, optical characterization is presented showing the samples are both highly transparent and photo-luminescent. Special attention is paid to analyzing structural and photoluminescence development during densification, as well as the role of oxygen vacancies on the optical properties of the densified material. This material is shown to be a promising candidate for a number of applications including luminescence thermometry and high temperature light emission.