"BNC/MSE Seminar"

December 12, 2014@ 3:30pm
Birck, ROOM 1001

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Title: Photon and phonon interactions with nanocrystalline materials: Engineering transparent materials for optical and energy applications

Abstract: The efficient generation and utilization of energy is one the most pressing issues in our society today. In this talk I will discuss our on-going effort in engineering transparent polycrystalline materials for efficient solid state lighting (SSL) and high power lasing applications. Both SSL and lasers can have a significant impact on mitigating energy loss. For example, switching to white light emitting devices (LEDs) could reduce the electricity consumption for lighting by nearly one half of today's levels. Similarly, high powered lasers processing reduces material loss and decreases material machining time, reducing overall electricity consumption. Our approach is to significantly increase the thermal conductivity (*k*) of laser gain media and white light conversion elements for LEDs because the power delivered by a solid state laser/lighting systems scales directly with the thermal conductivity of the photoluminescent host (e.g. 10 times the *k* of the host allows10 times the power output for a given pumping/cooling design). Our materials are transparent polycrystalline oxides and nitrides. One advantage of polycrystalline materials is that they can be produced efficiently, are tough and when doping for functionalities such as photoluminescence, they can have more uniform dopant distribution than single crystals grown from a melt. An even more enticing benefit is that careful processing can produce metastable structures with property combinations that are not possible with traditional processing methods. We will discuss how with control of processing parameters, one can tailor defect concentrations and/or sizes leading to very high-quality optical materials. Central to our goal is understanding the phonon and photon interactions with defects at different length scales so that we can tailor the microstructure to achieve the desired properties.

Bio: Javier E. Garay received his B. S. in Mechanical Engineering (1999), M.S. in Materials Science and Engineering (2002) and Ph.D. in Materials Science and Engineering (2004) all from the University of California, Davis. He is a Professor of Materials Science & Engineering and Mechanical Engineering in the Bourns College of Engineering at the University of California, Riverside. He also serves as Chair of Materials Science & Engineering Program. Prof. Garay is the principal investigator of a vibrant experimental laboratory called the Advanced Material Processing and Synthesis (AMPS) Lab. Research in AMPS Lab focuses on advanced material processing and synthesis with particular emphasis on designing the micro/nanostructure of bulk materials for property optimization. AMPS Lab also has in-house capabilities in property measurements and device design allowing seamless interplay between the design of materials and evaluation of material performance in devices. Prof. Garay has received two federal Young Investigator Program (YIP) awards: Army Research Office (ARO-YIP) in 2005 and Air Force Office for Scientific Research (AFOSR-YIP) in 2009. He also received the Faculty Early Career Development (CAREER) award from the National Science Foundation in 2010.

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