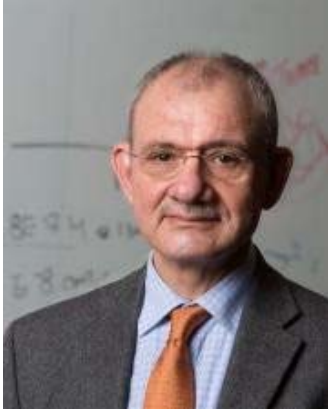


PURDUE MECHANICAL ENGINEERING



The Hawkins Memorial Lecture in Heat Transfer

Dr. Costas Grigoropoulos

Department of Mechanical Engineering

University of California, Berkeley

Friday, October 5, 2018

10:20 am ME 2054

Pulsed Laser Functionalization of Semiconductor Nanostructures

Abstract:

The crystallization of amorphous thin films is a critical fabrication step for enhancing the performance of thin-film transistors (TFTs) and thin-film solar cell devices. Typical thin-film materials offer cost-effective device fabrication routes but intrinsically suffer from low degree of crystallinity leading to necessary improvements by subsequent thermal annealing. Using a traditional furnace to increase crystallinity not only needs a large thermal budget but also has limitations in adopting inexpensive substrates. Annealing by pulsed lasers can significantly mitigate these issues by taking advantage of precisely localized heating and through control of the temporal evolution of the melt mediated process. Work conducted by the Laser Thermal Laboratory on laser-induced crystallization of semiconductor thin films and nanostructures is presented. The transient phase transformations induced by pulsed nanosecond and ultrafast laser radiation are monitored by in-situ time-resolved diagnostics and correlated with the ensuing structural modification. Laser-induced grain morphology change is observed in silicon nanopillars under a transmission electron microscopy (TEM) environment. The TEM is coupled with a near field scanning optical microscopy (NSOM) pulsed laser processing system. This combination enables immediate scrutiny on the grain morphologies that the pulsed laser irradiation produces. The microscopic observation in conjunction with heat transfer modeling provides a fundamental basis for laser-induced conversion of amorphous nanostructures into coarse-grained crystals. Scalable optically modulated writing of nanoparticle patterns using pulsed laser radiation is demonstrated. The nanoparticle arrangement is modulated by the laser pulse energy and polarization. Fast quenching of the nanodot melt induces phase switching and optical contrast that can be utilized for the fabrication of structural color metasurfaces.

Biography:

Costas Grigoropoulos received his Diploma Degrees in Naval Architecture and Marine Engineering (1978), and in Mechanical Engineering (1980) from the National Technical University of Athens, Greece. He holds a M.Sc. degree (1983), and a Ph.D. (1986), both in Mechanical Engineering from Columbia University. He was faculty in the Mechanical Engineering at the University of Washington in 1986-1990. In 1990 he joined the Department of Mechanical Engineering at the University of California at Berkeley. He has conducted research at the Xerox Mechanical Engineering Sciences Laboratory, the IBM Almaden Research Center and the Institute of Electronic Structure and Laser, FORTH, Greece. His current research interests are in micro/nano engineering, laser materials processing, laser-biomaterial interactions, microscale energy sources, microscale and nanoscale transport. His laboratory is focused on advanced methods for the manufacture of functional micro/nanoscale devices. He was a Miller Professor for basic research in science in 1999, a visiting Professor at ETH Zurich in 2000 and 2009 and a visiting Professor in Johannes Kepler University, Linz, Austria in 2008. He is a Fellow of ASME and SPIE, and recipient of the ASME Heat Transfer Memorial Award (2007). He is Editor of the *International Journal of Heat and Mass Transfer*.

Reception @ 10:00 a.m. – 10:20 a.m. — Room 2054, Mechanical Engineering Building