The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar

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Lecture Title: Lasers as Versatile Heat Sources for Renewable Energy Applications in Micro/Nano Scale

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Abstract

Lasers have proved to be effective tools for precise material processing & diagnostics taking advantage a variety of available thermal/non-thermal excitation mechanisms at wide range of temporal (down to femtosecond) and spatial (down to nanometric scale) domains. This talk is mainly devoted to the demonstration of versatile function of lasers as advanced manufacturing & diagnostics tools for green energy applications and the investigation of light-matters interaction mechanism aiming to an efficient utilization of renewable solar energy.

First part of the talk is focused on the phase change process by ultrafast lasers and chemical species analysis by laser-induced breakdown spectroscopy (LIBS). As a relevant practical example, improved results in laser scribing performance for the fabrication of thin film solar cell devices by ultrashort pulsed lasers will be shown, together with recently developed in-situ process monitoring capabilities by the LIBS technique.

As one approach to overcome traditional optical diffraction limit, optical near-field technology has been developed, and focused research activities on the utilization of the optical near-field as nanoscale heat sources are highlighted through a variety of nanoscale material processing examples. In addition, the optical near-field based nanostructures characterization examples, and coupled near-field illumination into the electron microscopes (SEM/TEM) for in-situ process monitoring and fundamental level understanding of light-matters interaction in nanoscale are introduced. Enhanced light absorption in the nanostructures greatly improves light-induced reaction in their close proximity. Recent research activities on localized reaction for solar hydrogen production and selective semiconductor nanowire growth by VLS mechanism triggered by optical far- & near- field based heating are briefly explained.

Lastly, nonlinear absorption and propagation characteristics of ultrashort pulsed lasers are exploited in order to enable unique micro/nanomanufacturing capabilities. Fabrication of nanometric size patterns and truly three-dimensional structures are displayed with highlighted applications in biological field and potential usage as energy devices are discussed.

Biography

David Hwang is a staff research scientist in Mechanical Engineering Department, University of California at Berkeley, and a guest scientist in Environmental Energy Technology Division, Lawrence Berkeley National Laboratory. He received his BSE and MSE degrees in Mechanical Engineering from Seoul National University in 1995 and 1997, respectively and Ph.D. degree in Mechanical Engineering from University of California at Berkeley in 2005, followed by postdoctoral research associate position from 2005-2008 in University of California at Berkeley. He also worked for Samsung Advanced Institute of Technology (SAIT), South Korea, from 1997 to 2000, where he was involved in automotive engine control, superconductor related cryogenics and micro-jetting device. His major research interests are various thermal/nonthermal micro/nano scale processing & diagnostics of electronic/photonic/solar energy related/biological materials based on lasers.

Directions: Please call Augusta Kuhn at 631-632-8310 for more information.

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