

ME DEPARTMENTAL SEMINAR

Friday, October 14, 2005

1:00pm – 2:00pm

2233 GG BROWN

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“LASER-BASED MICRO/NANOPROCESSING AND MEMS DIAGNOSTICS”

Abstract:

Recent work on the processing of thin semiconductor films for the fabrication of thin film transistors (TFTs) in high performance large area electronics will be presented. Femtosecond laser radiation is shown to be effective for the precise machining of materials. The ultrafast energy deposition drives non-equilibrium phase transformations that are monitored by time-resolved optical diagnostics. Furthermore, the high laser intensities drive nonlinear optical absorption in dielectric materials that allows internal micromachining for the fabrication of microfluidic channels. Local field enhancement in the near-field of a SPM probe tip irradiated with femtosecond laser pulses was utilized for nanomachining in an apertureless near-field-scanning-optical microscope (NSOM) arrangement. Finite Difference Time Domain (FDTD) simulation results for the spatial distribution of the laser field intensity near the tip are shown and compared with measured data. Various results of nanostructuring of metal, amorphous semiconductor thin films and nanodeposition using both apertureless and fiber-coupled NSOM schemes are presented. The concept of effective laser curing of nanoparticle suspensions (NPS) with a laser beam is described. A toluene solvent is employed as the carrier of gold nanoparticles possessing a lower melting temperature than that of bulk gold. Using a modified drop on demand jetting system, the gold nanoparticle suspended solution is printed on a glass substrate and cured with laser irradiation. The laser energy coupling to the nanoparticles in conjunction with thermocapillary effects and the evaporation of the solvent are critical to the quality of the electrically conductive gold micro-lines. By employing a “double” laser beam processing scheme to optimize the curing process, it is shown that the gold nanoparticles could be sintered on a glass substrate to form a gold line of resistivity close to that of bulk gold.

Work on MEMS-scale diagnostics will also be reported. Piezoelectrically driven flow in print manifolds is analyzed via micro-Particle-Image-Velocimetry (mPIV) measurements in conjunction with theoretical modeling. Minute movements of liquid matter due to compressibility are captured and acoustic boundary layer reversal phenomena resolved. The Infrared Thermal Velocimetry, a new technique is utilized for non-intrusively measuring fluid flow in silicon fluidic systems.