CMP Seminar

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Depth-dependent studies of electron and phonon ultrafast dynamics in femtosecond laser-induced transient states of matter

Ultrafast laser pump-probe interactions with dielectric materials far from equilibrium provide a unique approach to characterize and non-thermally modify these material systems [1-4]. For example, short-pulse laser induced coherent acoustic phonons (CAP) provide a moving surface, indeed a moving mirror, which, when used in a simple reflection probe mode, has been shown to reveal strain, defect concentrations, and impurity concentrations as a function of depth with unparalleled sensitivity and depth resolution [4]. This has opened exciting new avenues of exploration in the fields of nanoscale materials characterization and manipulation. To extend this approach, the realization that the CAP wave does indeed constitute an actual moving surface, suggests that surface physics techniques that have been routinely applied to characterize normal surfaces and interfaces may be applied to the CAP surface.

In this presentation we will discuss ongoing research involving (a) fundamentals of coherent acoustic phonon spectroscopy, (b) semiconductor point defect concentration profiles measured using CAP waves, and (c) approaches for accomplishing depth dependent materials modification involving transient states of matter.

Keywords: Lasers, ultrasonics, ultrafast nonequilibrium dynamics, Vanderbilt

References

[1] A. Baydin, H. Krzyzanowska, L. Feldman and N. Tolk, *"Post-implantation depth profiling using time-domain Brillouin scattering,"* Nuclear Instruments & Methods in Physics Research, section B Beam interactions with Materials and Atoms, **440, 2019,** Pages: 36-40

[2] W. F. Paxton, M. Yilmaz, A. Mayo, J. Kozub, M. Howell, J. Gregory, J. E. Butler, W. P, Kang, R. Mu, J. L. Davidson, N. Tolk, *"Low temperature diamond growth arising from ultrafast pulsed-laser pretreatment,"* CARBON, **131, 2018,** Pages: 120-126

[3] A. Baydin, H. Krzyzanowska, R. Gatamov and N. Tolk, *"The photoelectric coefficient P12 of H+ implanted GaAs as a function of defect density,"* Nature SCIENTIFIC REPORTS, **7, 2017,** Article No. 15150

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Monday, October 21st, 2019 at 4:10 p.m.
Room 1400 BPS Bldg.
Host: Chong-Yu Ruan