APR06-2005-000063

Abstract for an Invited Paper
for the APR06 Meeting of
the American Physical Society

Infrared Pulsed Laser Deposition: Applications in Photonics and Biomedical Technologies[1]

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Resonant infrared pulsed-laser deposition (RIR-PLD) shows significant promise for synthesizing thin films of small organic molecules, thermoplastic and thermosetting polymers and biopolymers, without compromising structure or functionality. This contrasts with most attempts at UV-PLD of organic materials, which have often been accompanied by severe photochemical or photothermal degradation of the ablated material. Representative recent successes in RIR-PLD include deposition of: polymers for light emission and hole transport; functionalized polymers and nanoparticles for chemical and biological sensing; and biocompatible polymers suitable for coating medical devices or drug-delivery vehicles. Plume imaging and various other optical- and mass-spectroscopy experiments appear to confirm that polymers or organic molecules ablated by resonant infrared laser irradiation experience a high spatial and temporal density of vibrational excitation, but tend to remain in the electronic ground state. The mechanism of RIR-PLD is observed to depend on the anharmonicity of the mid-infrared absorption modes, their finite relaxation time, mode-specific nonlinear absorption, and rapid changes in polymer viscosity as a function of temperature. Many of the RIR-PLD experiments to date were carried out using a tunable, mid-infrared, picosecond free-electron laser. However, if RIR-PLD is to become a practical tool for making organic thin films, it will be necessary to develop more conventional lasers that can achieve a similar combination of high pulse intensity, low pulse energy, high pulse-repetition frequency and moderate average power. In conclusion, the prospects for developing precisely such table-top RIR-PLD systems will be discussed.

[1]In collaboration with D. M. Bubb, N. L. Dygert, J. S. Horwitz, S. L. Johnson, M. R. Papantonakis and K. E. Schriver. Supported by the Naval Research Laboratory and the Medical Free-Electron Laser Program of the Department of Defense.