

ME **Spring Seminar 02**

Ultrafast Laser Chemical Vapor Deposition for All-Surface 3D Carbon Circuitry: Fundamental Mechanisms and Interfacial Property Control

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Creating arbitrary-shaped 3D electrodes on all surfaces of transparent substrates—including the front, rear, and even the inside of enclosed architectures—is critical for next-generation semiconductor packaging, micro-displays, and highly sensitive bio/chemical sensors. In this seminar, we introduce Ultrafast Laser Chemical Vapor Deposition (ULCVD), a novel, mask-free approach that enables the direct writing of highly conductive carbon patterns on various transparent dielectrics. By precisely controlling the nonlinear multi-photon absorption of femtosecond laser pulses, we induce highly localized photothermal reactions at the laser-glass interface, successfully overcoming the limitations of conventional multi-step lithography to achieve true 3D integration of conductive networks. Furthermore, to gain a deeper understanding of the physical and chemical dynamics of this process, we will systematically investigate the electrical and interfacial properties of the carbon patterns, with a specific focus on borosilicate glass. We will discuss how spatial parameters, such as the laser focus offset, govern a crucial trade-off between electrical conductivity (achieving sheet resistance down to $\sim 2.7 \Omega \text{ sq}^{-1}$) and adhesion stability. This part of the talk will highlight the fundamental mechanisms of interfacial hybridized bonding (e.g., sp^2 carbon, C-Si, and Si-O-C) and mechanical interlocking driven by extreme laser-matter interactions. Ultimately, this presentation will bridge the foundational physics of laser-induced crystallization with practical optimization strategies, demonstrating the breakthrough potential of ULCVD for advanced glass-based electronics and 3D integration technologies.

**Bldg.110 #N105****16:00 - 17:15**Wednesday, **March 25**

Host:

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