

Nanofabrication Seminar | Beyond Electron Beam Lithography: Nanopatterning with the Helium Focused Ion Beam

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12:00 to 13:00

Seminar Room

High-resolution nanopatterning is central to current research in condensed matter physics and photonics. Examples are electrostatic superlattices that engineer the electronic band structure or photonic crystals that control the propagation of light. In both cases, the phenomena of interest emerge only when nanostructures are patterned with sufficient precision and minimal disorder. Required feature sizes range from a few nanometers to micrometers, and patterned areas span from micrometers to centimeters. Yet across these fields, a common challenge remains: minimizing pattern disorder.

The most widely used nanopatterning methods, optical and electron beam lithography, are accessible and capable of patterning large areas with reasonably small pitch. However, they involve multi-step resist-based processing that can limit resolution and introduce contamination, particularly for sensitive materials. An alternative is the helium focused ion beam (He-FIB), a nanofabrication tool that enables direct, resist-free patterning with single-feature sizes of a few nanometers.

In this seminar, I will introduce the general working principles of the He-FIB available at ICFO and its advantages over conventional lithography techniques. I will then present a nanopatterning technique based on He-FIB milling of a hard etch mask, capable of producing periodic two-dimensional arrays in two-dimensional materials with sub-20 nm pitch and minimal disorder. Finally, I will discuss how this technique can be extended to other material systems, its current limitations, and further applications.

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