הטכניון - מכון טכנולוגי לישראל
TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar
Lecture Hall 6, Wolfson Department of Chemical Engineering,
Wednesday March 28th at 1:30pm

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Hierarchical Electrohydrodynamic Lithography for Advanced Miniaturised Devices

High resolution lithography is one of the cornerstones of electronic technologies. While these are based on conventional optical projection methods, a range of alternative techniques have emerged over the past 10 years for the control of pattern replication on the 10 nm to 1 µm length scale. Electrohydrodynamic (EHD) patterning takes lithography to a new level by the development of techniques that control structure formation within the replicated material down to the atomic level. This results in the controlled manufacture of design patterns with hierarchical feature sizes.

This overview is centred on the electro-hydrodynamic lithography (EHL) technique, in which a design electrode pattern is replicated into a polymeric resist by electric field-gradient forces. This method reliably produces faithful replicas of a master-pattern with feature sizes down to 100 nm. This well-established EHL process provides additional handles that permit control over the arrangement of the material within the lithographically produced structures. We develop several hierarchical pattern replication methods, demonstrating the creation of functional thin films with 3D design patterns. EHL contributes to a fundamental understanding how electric fields can be used to control the arrangement of material down to the nanometre length scale and demonstrates the promise of electric field-assisted techniques in the control of a range of functional materials.

The central part of the EHD lithography will be concerned with the structure formation of conducting and semiconducting materials by EHL, which is challenging because of the high electric fields employed in this method and the associated risk of short-circuiting the devices. The EHD demonstrates successful structure control in semiconducting polymers, block-copolymers, and polymers loaded with carbon nanotubes. In addition to the control over the distribution of optoelectronically active materials in thin films, the work also shows how nanometre-sized conducting domains within these materials can be aligned. In addition, other uses of EHL are explored, such as the control over crystallinity within the replicated material and in particular, the use of submicrometre-sized design topographies for sensing by means of surface-enhanced Raman scattering.

Refreshments will be served at 1:15pm