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 June 27th at 1:30pm

Mohammad Abo Jabal

PhD student (supervisor: Prof. Ofer Manor)
Department of Chemical Engineering, Technion

Evaporative Self Assembly -Pattern Deposition- of Polymers from Volatile Solutions in Confined Geometry

Evaporative self-assembly processes have revolutionized industry and academia as an efficient and cost effective method for the pattern deposition of a wealth of well-defined and functional structures. Nevertheless, a thorough investigation of the physical mechanisms determining the different states of depositions is required for predicting the morphology of the deposit a priori.

In this study we systematically investigate the physical mechanisms which are responsible for bifurcations in the state of deposition of polymers from volatile solutions.

We employ a microfluidic chamber as a well-defined model system, in which we vaporize a solution of poly-methyl-methacrylate (PMMA) in toluene. We observe different deposition patterns when varying the molecular mass of the polymer, the initial polymer concentration, the temperature, and dimensions of the micro-chamber.

The occurring qualitative transitions in the deposition of the polymer are studied in detail and are presented in the form of morphological phase diagrams. The motion modes of the three-phase contact line between the solution, its vapor, and the substrate correlates directly with the state of deposition. Both change with the Peclet number, characterizing the ratio between rate of polymer convection (which results from solvent evaporation) and the rate of polymer diffusion. The later is connected to the molecular mass of the polymer. At low Peclet numbers the contact line moves monotonically and deposition is continuous, producing a homogeneous deposit layer. At larger Peclet numbers, we observe for the first time an oscillatory motion of the contact line; the deposition is then periodic, producing a stripe pattern. The oscillatory motion differs from the well-known stick-slip motion reported in the absence of confinement. This oscillatory motion is attributed to opposing influences of evaporation and Marangoni flows. In particular, the Marangoni contribution results from the dependence of the surface tension of the solution on polymer concentration.

Refreshments will be served at 1:15pm