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 April 3rd at 1:30pm

Prof. Tatiana Gambaryan-Roisman

Institute of Technical Thermodynamics, Department of Mechanical Engineering
Technische Universität Darmstadt, Germany

Modelling complex wetting phenomena

Static and dynamic wetting of solid surfaces by liquids is a focus of numerous theoretical, computational and experimental investigations. In particular, wetting of simple solids by one-component liquids is satisfactorily understood. However, a wide variety of industrial processes include wetting/spreading of liquids over deformable, heterogeneous, structured or (nano)porous solids. In addition, in many applications wetting is coupled with transport processes and phase change. The mechanisms of those complex fluid-solid processes are still not completely understood. The development and optimization of the industrial processes and products is based on purely empirical trial and error methods.

In this talk I shall present the multiscale modelling approach developed for numerical description of flows, in which evaporation in the vicinity of apparent three-phase contact line plays an important role. The distribution of film thickness and of evaporation flux in the immediate vicinity of the apparent contact line is modelled accounting for the influence of disjoining pressure effect and of interfacial resistance to evaporation. The apparent contact angle and heat flow per unit length of contact line are computed and used in a subgrid model for simulation of macroscale phenomena, such as drop impact onto a heated wall.

A model for description of wetting of deformable substrates will be presented. Sessile liquid droplets deposited on soft substrates may cause the substrate to deform. The substrate elasticity affects the apparent contact angle and the spreading dynamics of the sessile drop. A model for description of a droplet on an elastic substrate is developed using the disjoining pressure concept. A Finite Element Method for the solution of elasticity problem in a substrate is coupled with lubrication approximation for the modelling of droplet spreading. The disjoining pressure model allows an independent definition of contact angle and the thickness of the adsorbed layer. Simulations are performed to quantify the influence of mechanical properties, the substrate size and the parameters of disjoining pressure on the substrate deformation and apparent contact angle.

Finally, a model of liquid imbibition coupled with evaporation on substrates with topography will be presented.

Refreshments will be served at 1:15pm