הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

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

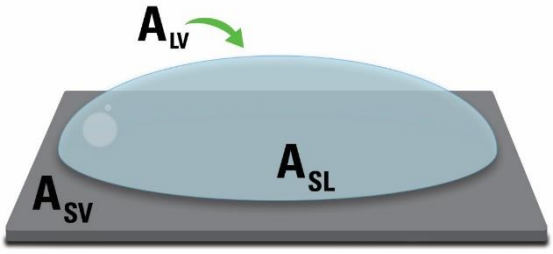
Wolfson Department of Chemical Engineering Special Seminar
Lecture Hall 6, Wolfson Department of Chemical Engineering,
Monday June 3rd 2019 at 1:30pm

Prof. Warren J. Jasper
North Carolina State University
NC, USA

Dependence of Contact Angle on Droplet Volume: Why Theory Fails to Agree with Experimental Data

For that past two hundred years, over a thousand papers have been written involving the contact angle of sessile oil droplets. The Young-Dupre equation suggests that the static contact angle is only a function of the surface energies, and is therefore an intensive thermodynamic property that is independent of droplet volume. The "modified" Young's equations adds an extensive line tension term to account for the free energy at the three phase line boundary, which was first suggested by Gibbs. The range of line tension values reported in the literature vary by over four orders of magnitude and in sign, making the definition as well as the experimental design highly controversial. There have been many attempts to explain away the discrepancy between the Young-Dupre equation and experiment via Lennard-Jones potential, Van der Waals forces, dispersive forces, and non-continuum arguments.

Advances in metrology over the past 20 year and better experimental design have validated the spherical cap shape of nano droplets. This geometric observation, together with the inclusion of a VdP term (and Laplace pressure) in the work variation function leads naturally to a state equation that is cubic in the cosine of the contact angle and accounts, within experimental error, for the relationship between contact angle and droplet radius over a range of 12 orders of magnitude in volume.



$$\cos(\theta)+\frac{\gamma}{3\gamma_{LV}}\left(2+\cos(\theta)-2\cos^2(\theta)-\cos^3(\theta)\right)=\frac{(\gamma_{SV}-\gamma_{SL})}{\gamma_{LV}}+\frac{k}{\gamma_{LV}a}$$

Refreshments will be served at 1:15pm