

Physical and Chemical Design of Superhydrophobic/hydrophilic Surfaces

[Glen McHale](#) and M. I. Newton

Department of Chemistry and Physics
The Nottingham Trent University
Nottingham NG11 8NS, UK

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Overview

1. Superhydrophobic Surfaces

- Lithography – designer surfaces 2-50 μm
- Etching – Cu surfaces 20-50 μm
- Sol-gel approach – phase separation 100 nm – 20 μm
- Conversion superhydrophobic \leftrightarrow superhydrophilic

2. Characterisation

- Contact angles
- Confocal and electron microscopy

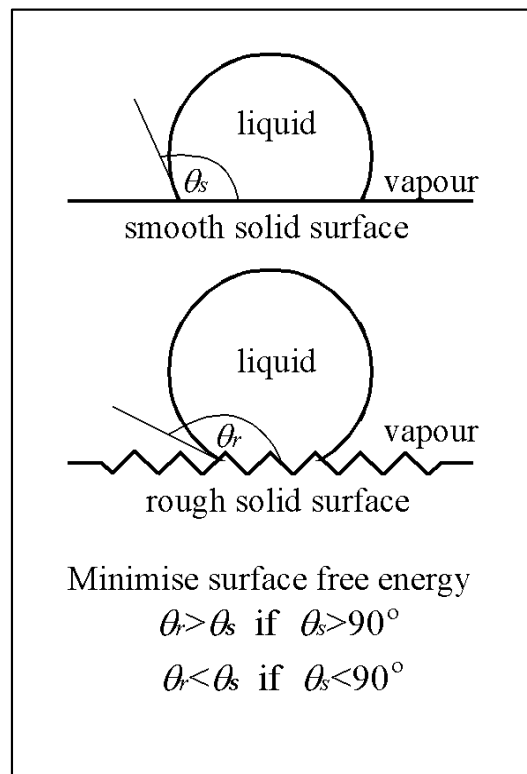
3. Measurements and Theory

- Static angles
- Dynamic angles

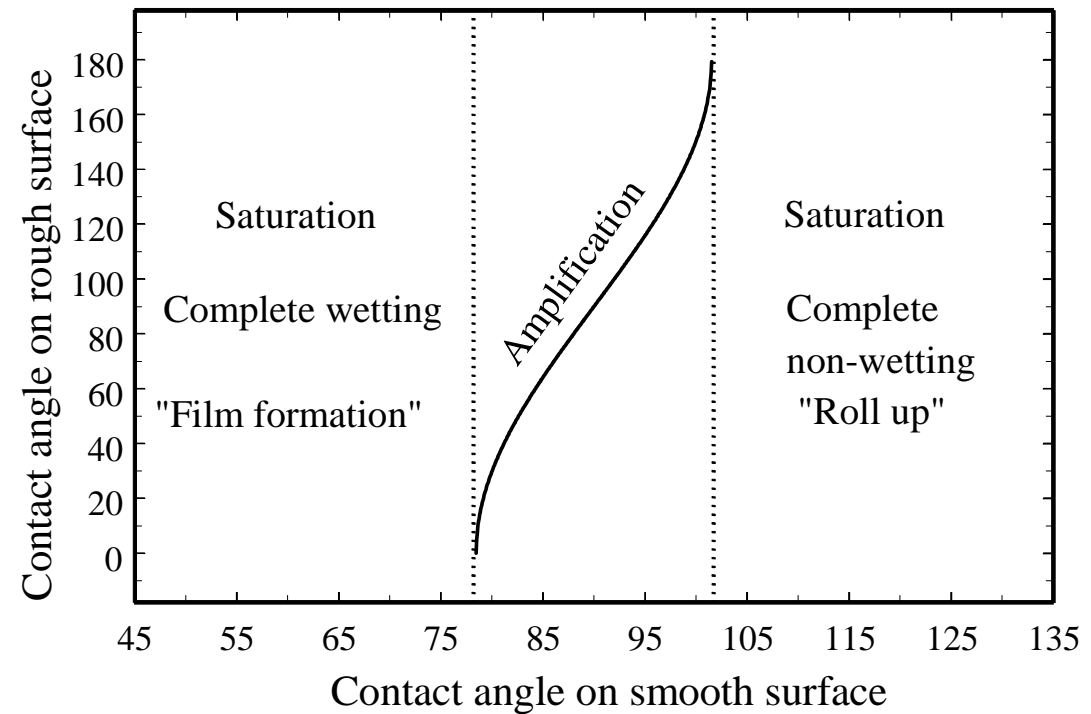
Superhydrophobicity

- Principles of Superhydrophobicity/hydrophilicity

Surface Roughness



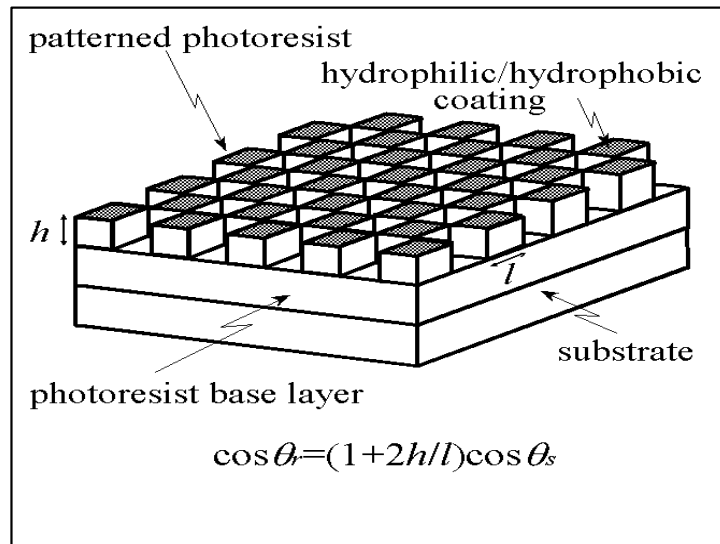
Contact Angle Modification



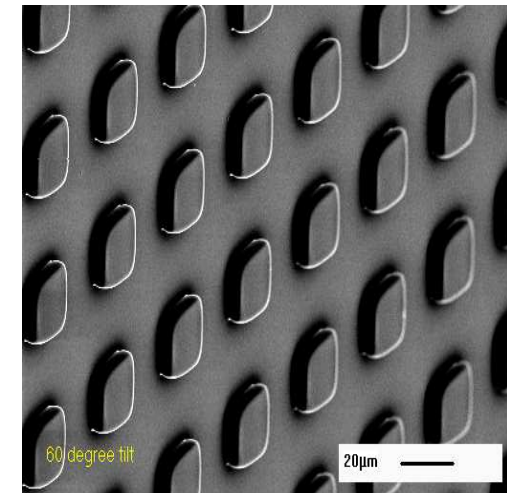
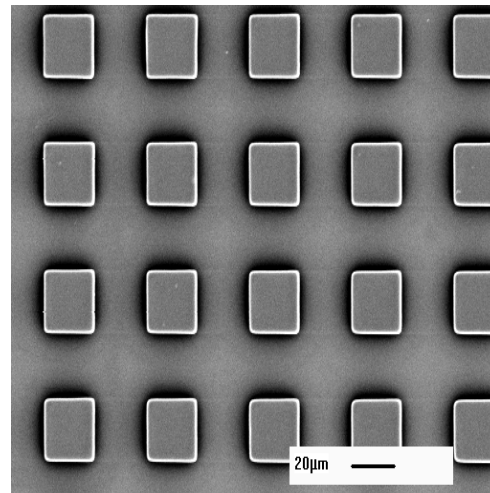
Superhydrophobicity

- Lithographic Approach

Principles



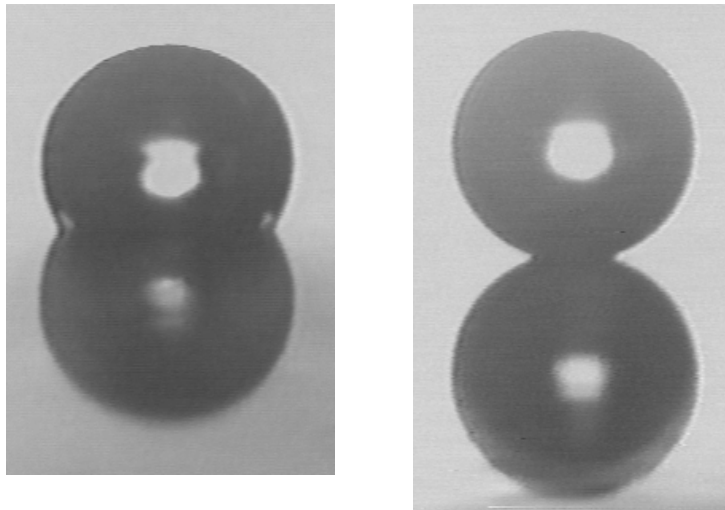
Electron Microscope Images



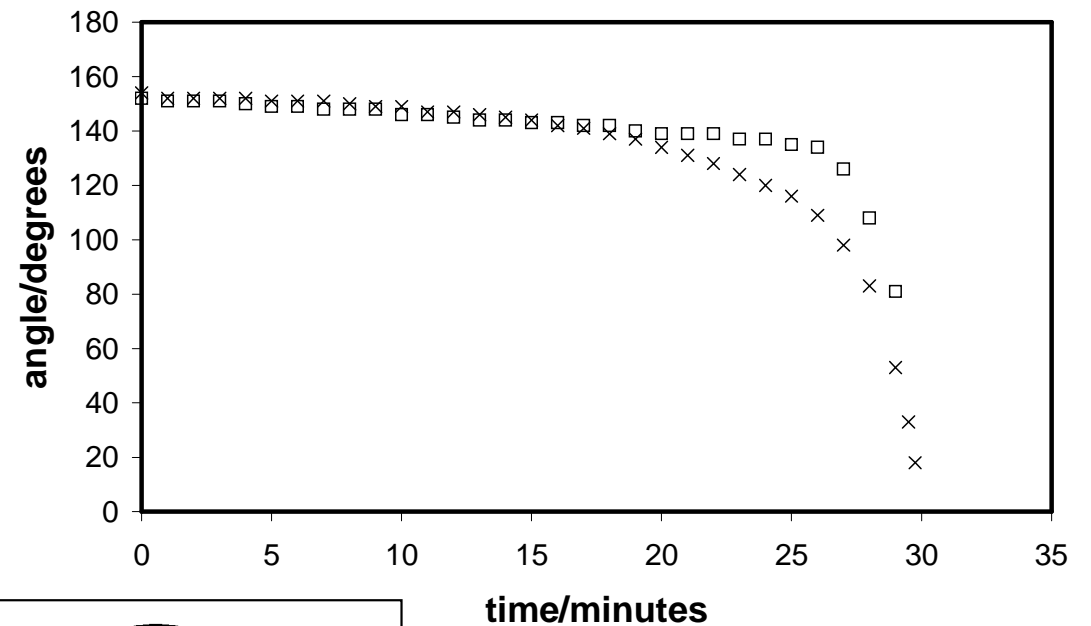
Superhydrophobicity

- Typical Result – Lithography and etching

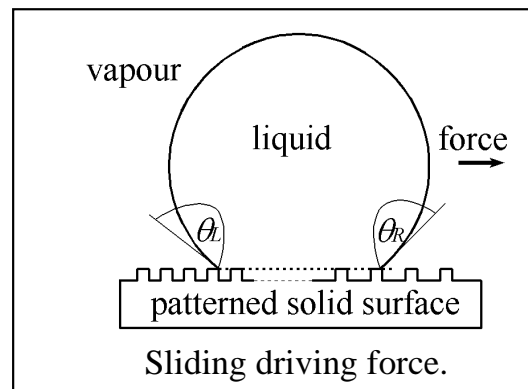
Equilibrium Angle



Evaporation Sequence



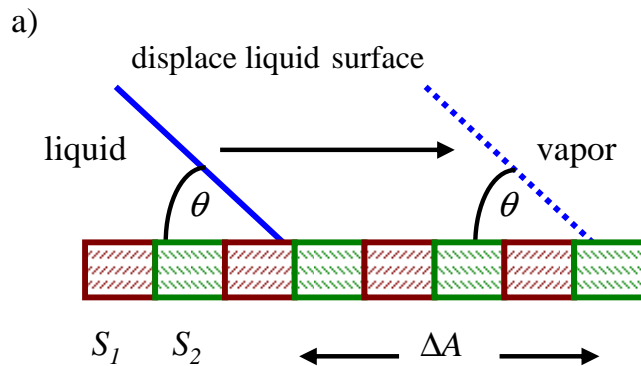
- Unequal Angles →



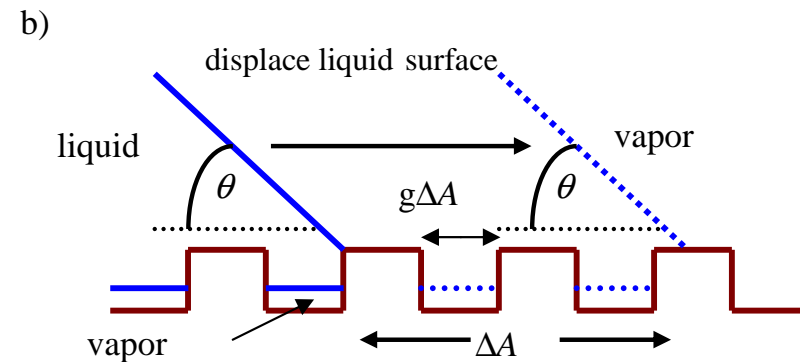
Dynamics on SuperWetting Surfaces

- Theoretical Work

Chemically Heterogeneous



Physically Structured



Changes in surface free energy by displacement of surface.

$$v_E = \left(\frac{2\pi\gamma_{LV}}{k\eta} \right) \tan(\theta/2) [fI_1 + (1-f)I_2 - \cos\theta]$$

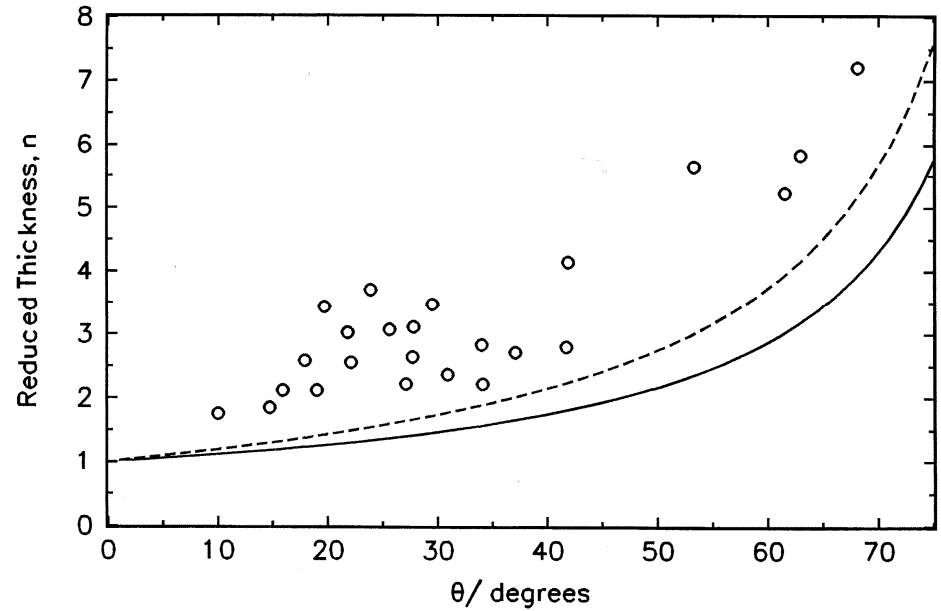
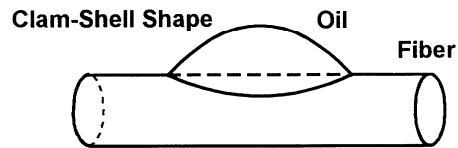
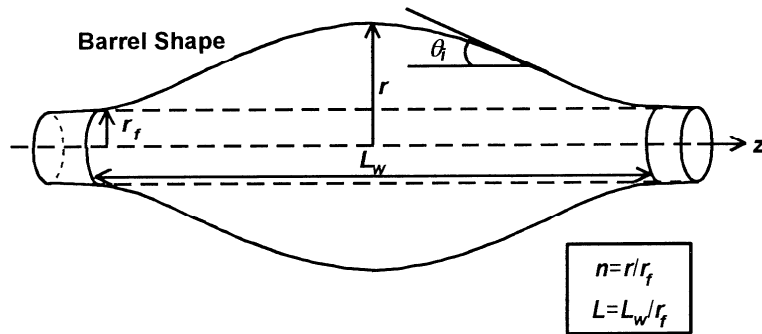
$$v_E = \left(\frac{2\pi\gamma_{LV}}{k\eta} \right) \tan(\theta/2) [frI - g - \cos\theta]$$

Modified Tanner's Law

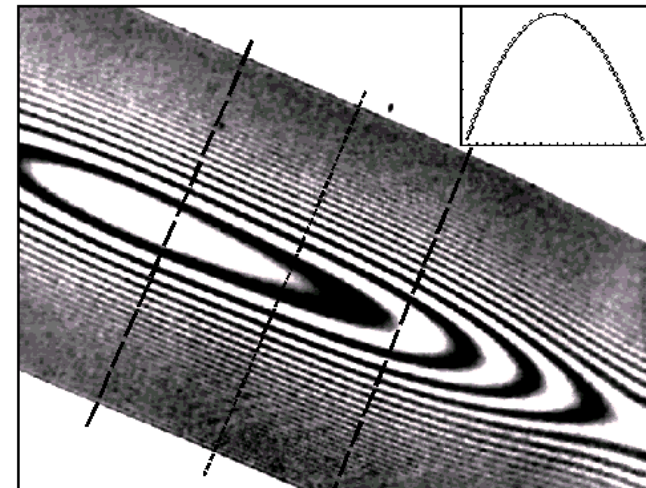
$$\theta = \frac{A(fr - g - 1)}{(t + C)^{3/4}} \sim \frac{1}{t^{3/4}}$$

Other Work on Wetting

- Fibers and Roll-Up

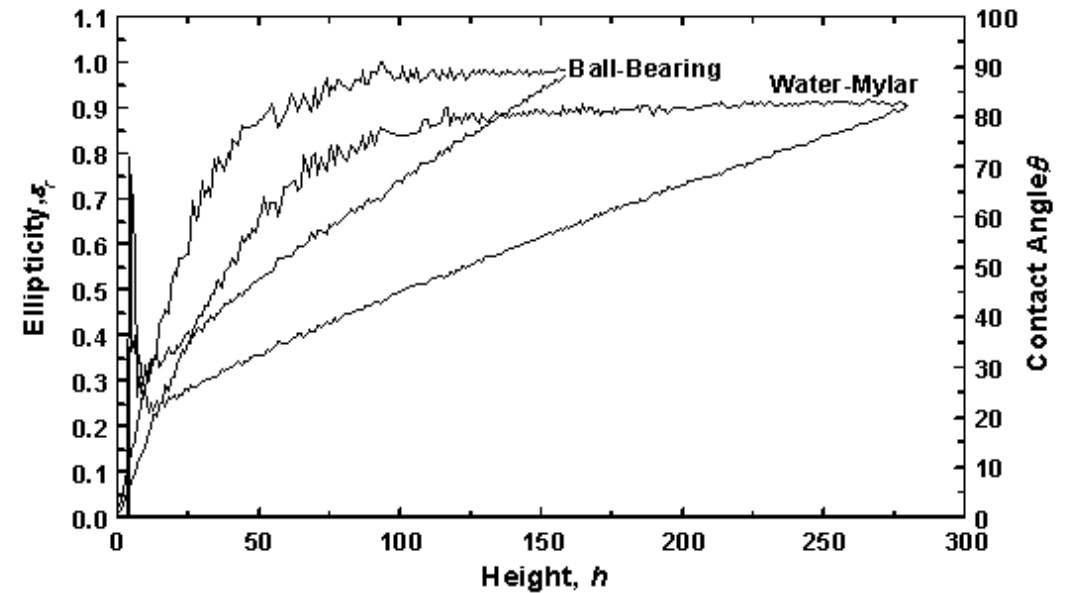
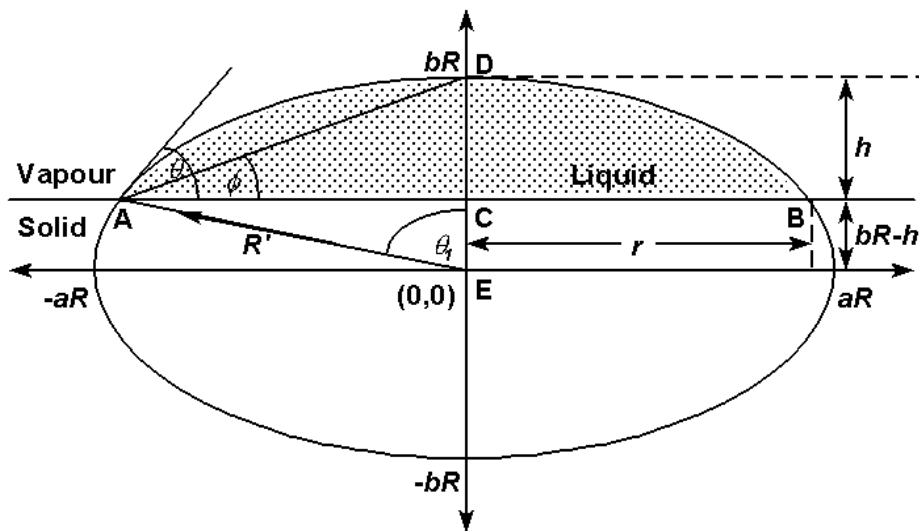


- Spreading of Oil Stripes



Other Work on Wetting

- Drop Shape Analysis



- Evaporation of Mixtures

Assorted experiments and theory