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Analysis of the Evaporation of Water Droplets from Textured Surfaces

Neil Shirtcliffe, Sanaa, Aqil, Glen McHale, Michael Newton and Y. Erbil

Lei Zhai et. Al.

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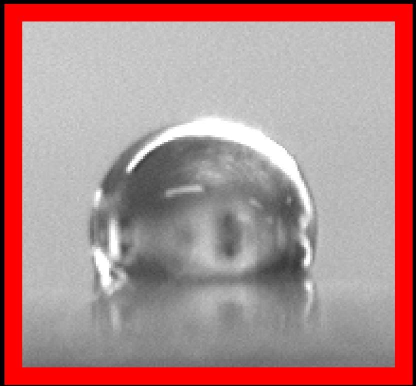
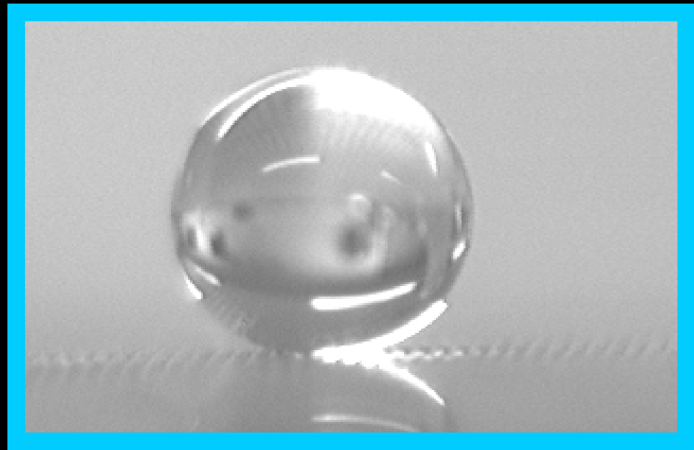
Superhydrophobicity





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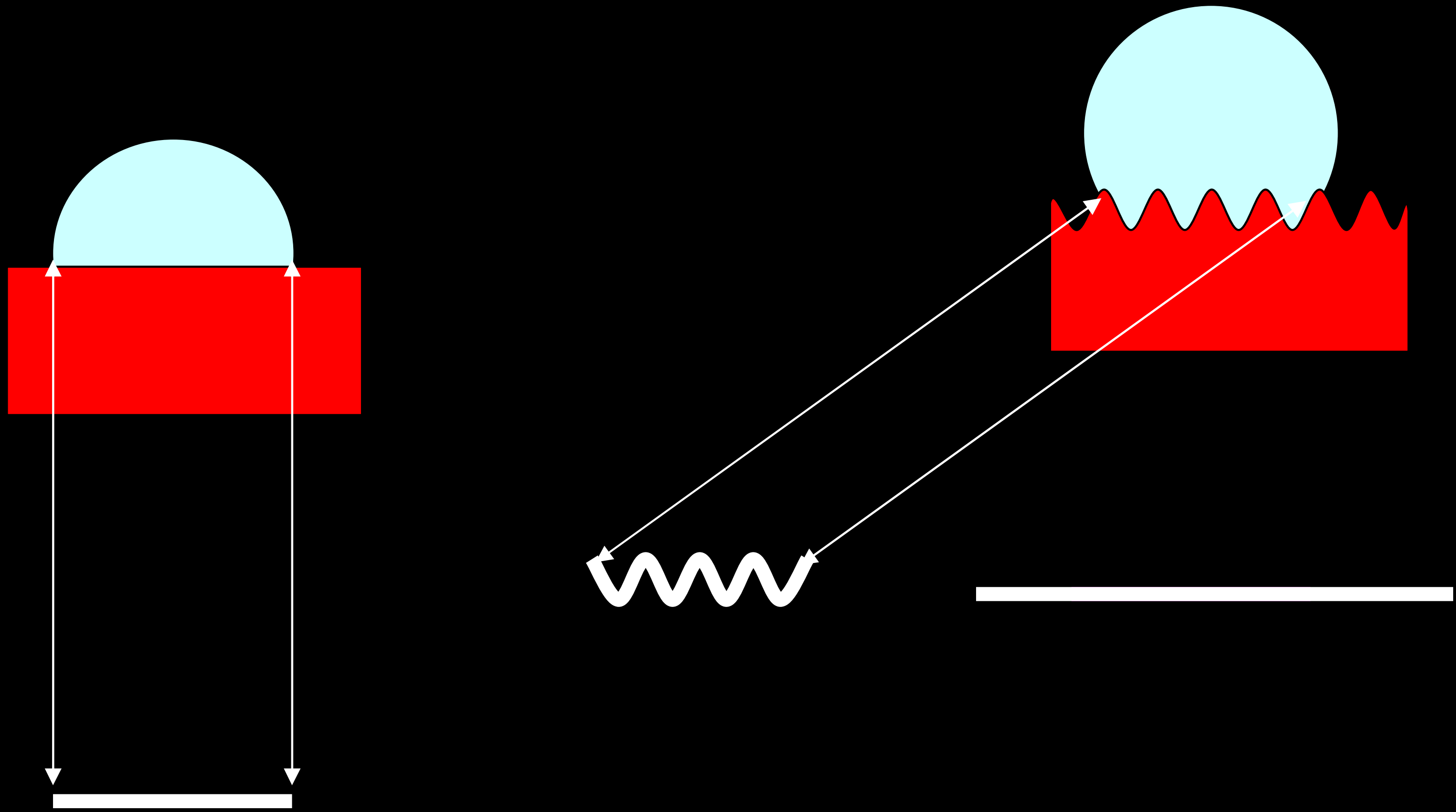
Wenzel Mechanism



$$\cos\theta_r = r\cos\theta_s$$

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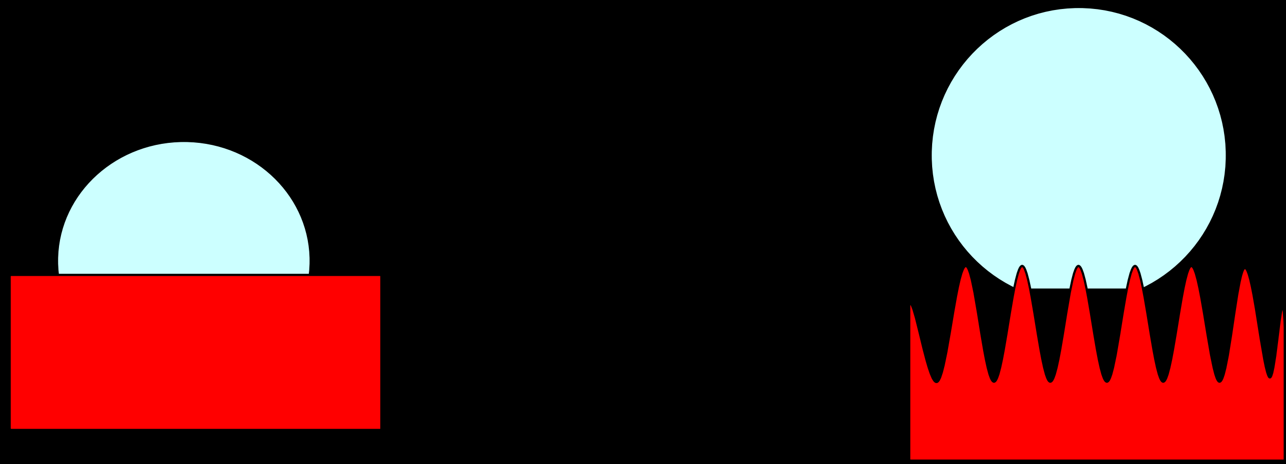
Cassie-Baxter Mechanism



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Richard Burkmar 2004

Rosemary Calvert

Ken Love

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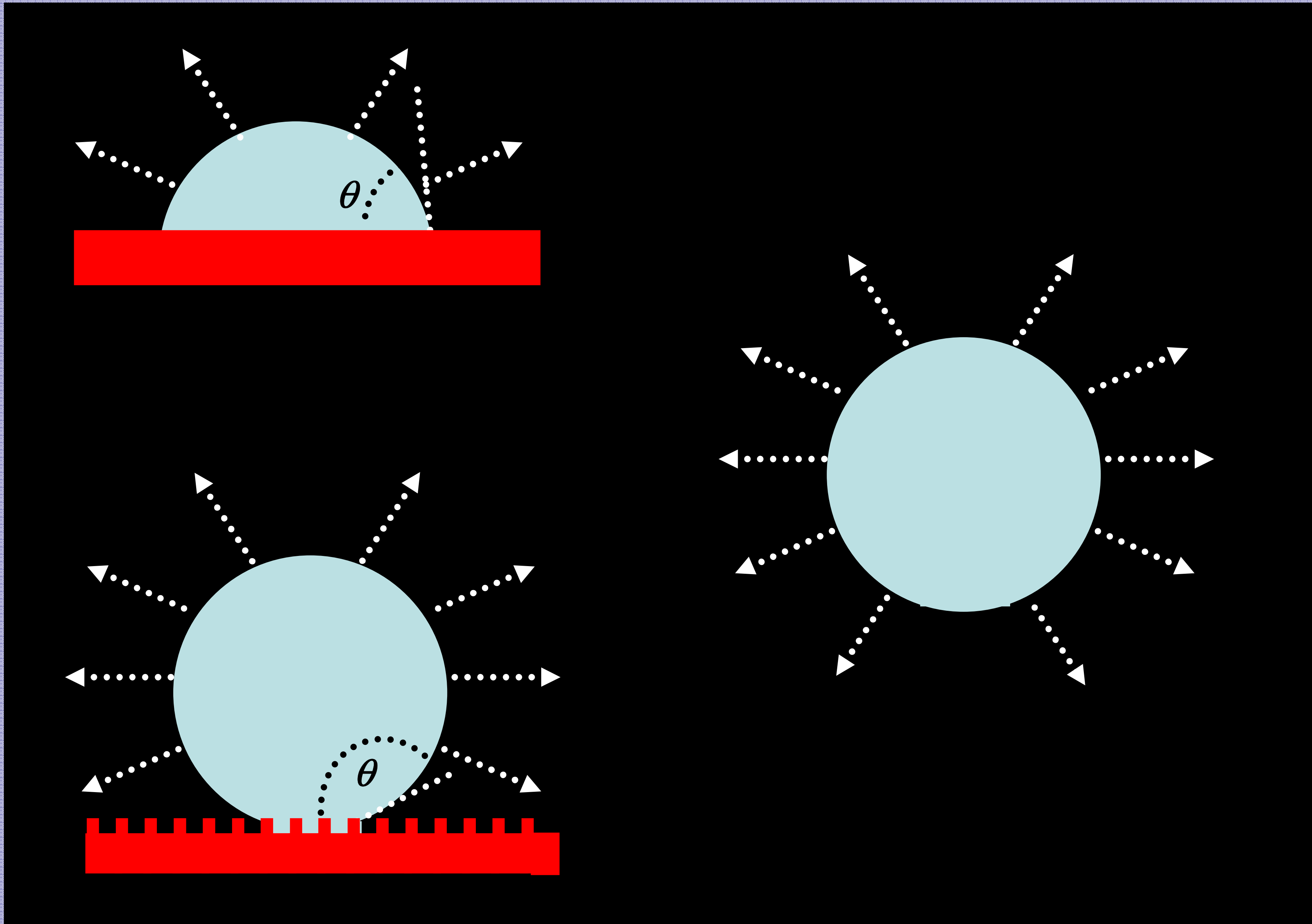

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Spherical drop in free space

$$\rho_L \frac{dV_C}{dt} = -4\pi R_S D\Delta c$$

Picknett and Bexon, drop on a surface

$$\rho_L \frac{dV_C}{dt} = -4\pi R_S D\Delta c f\left(\theta\right)$$

Approximation for 90 to 180°

$$H_{PB}(\theta) \equiv \frac{-e_0}{1+u} + e_1 \log_e(1+u) + e_2 u + e_3 u^2 = \frac{-2D\Delta c t}{\rho_L r_b^2} + H_{PB}(\theta_o)$$

$u(t) = \cos\theta(t)$

$$D\Delta c$$

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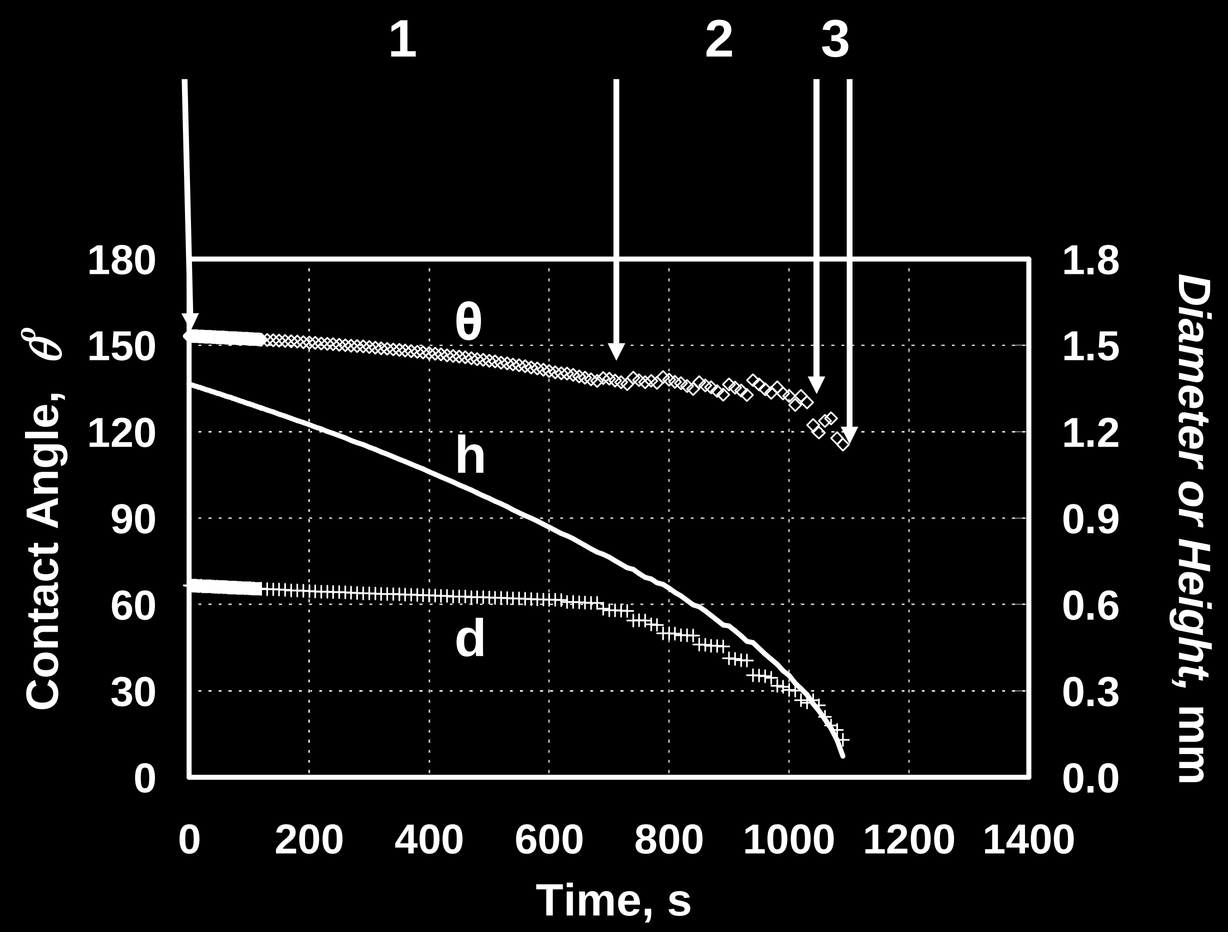

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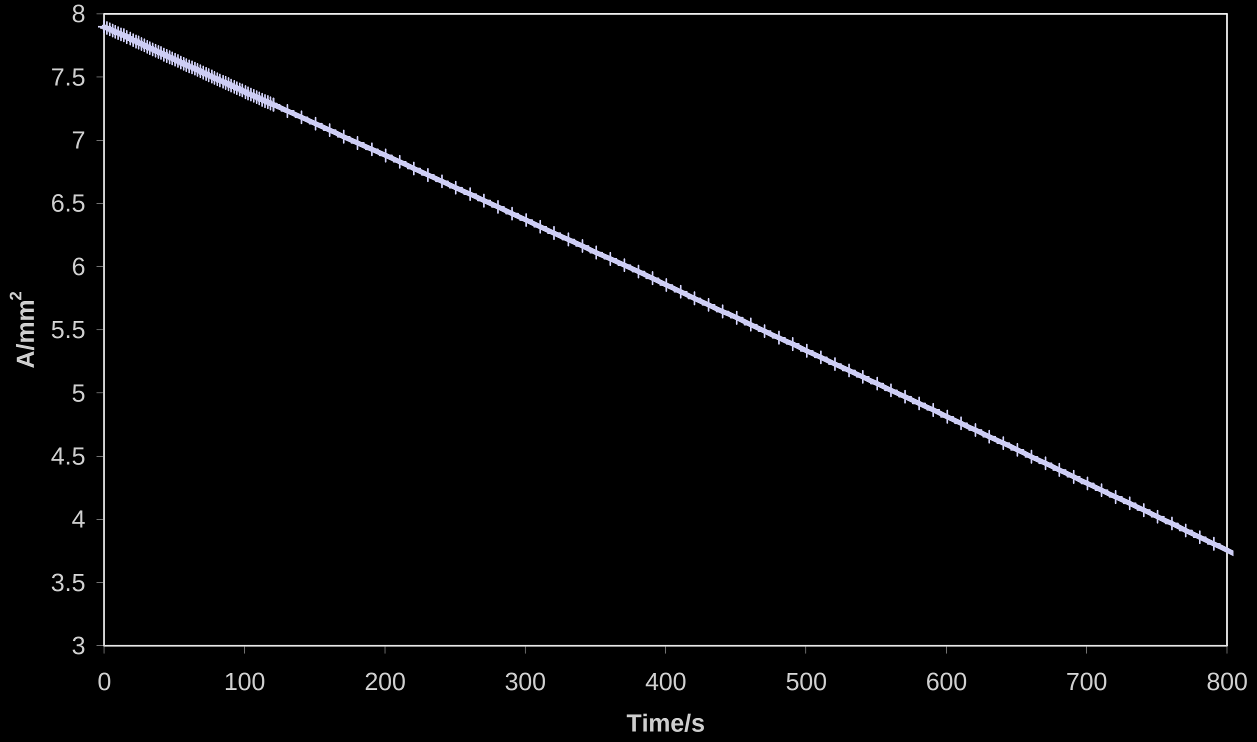
For Stage 1 it is possible to model the evaporation with a constant contact radius, 2, 3.

$$\left(\frac{dA_{LV}}{dt}\right) = \frac{-8\pi D\Delta c f(\theta)}{\rho_L}$$



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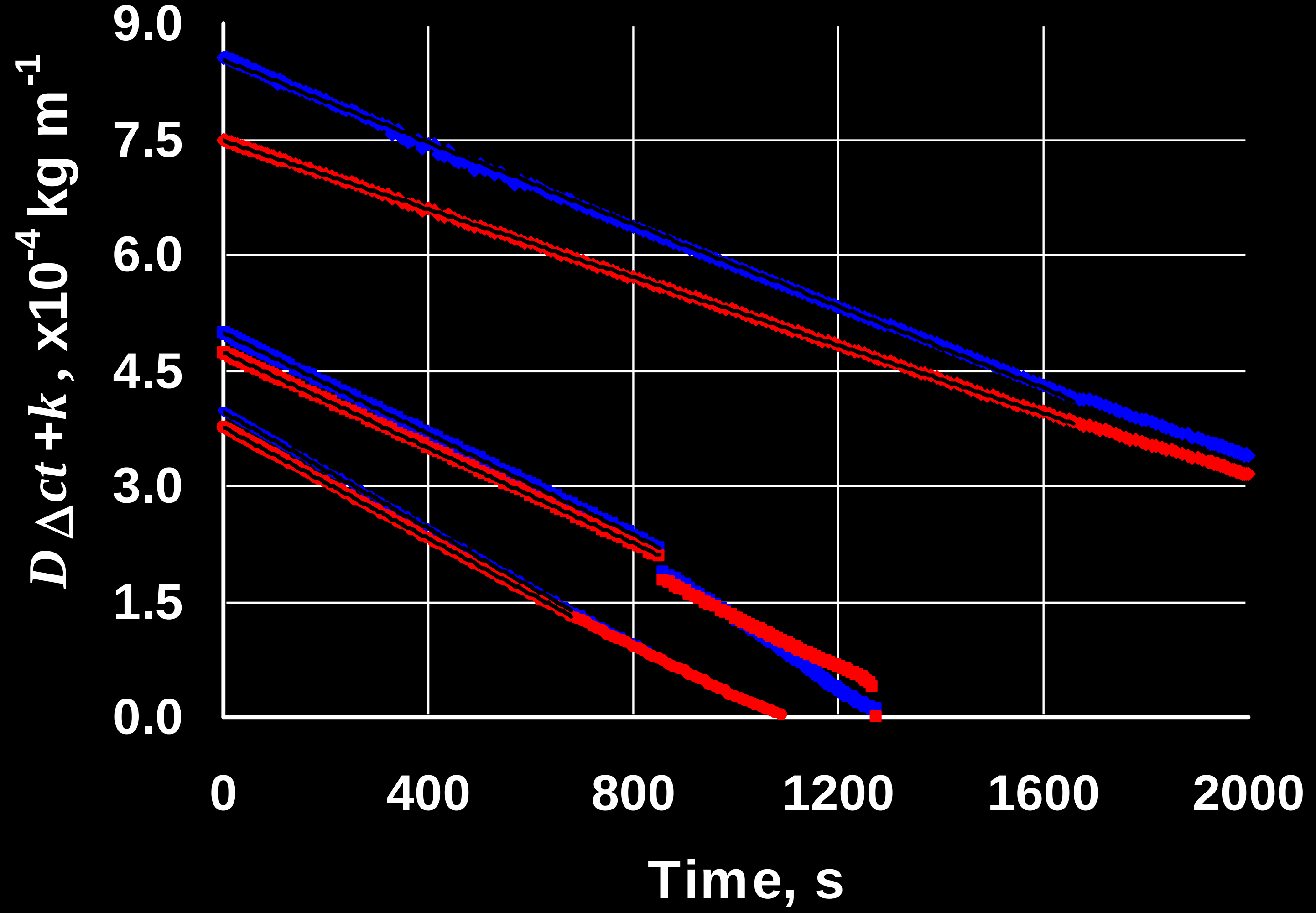

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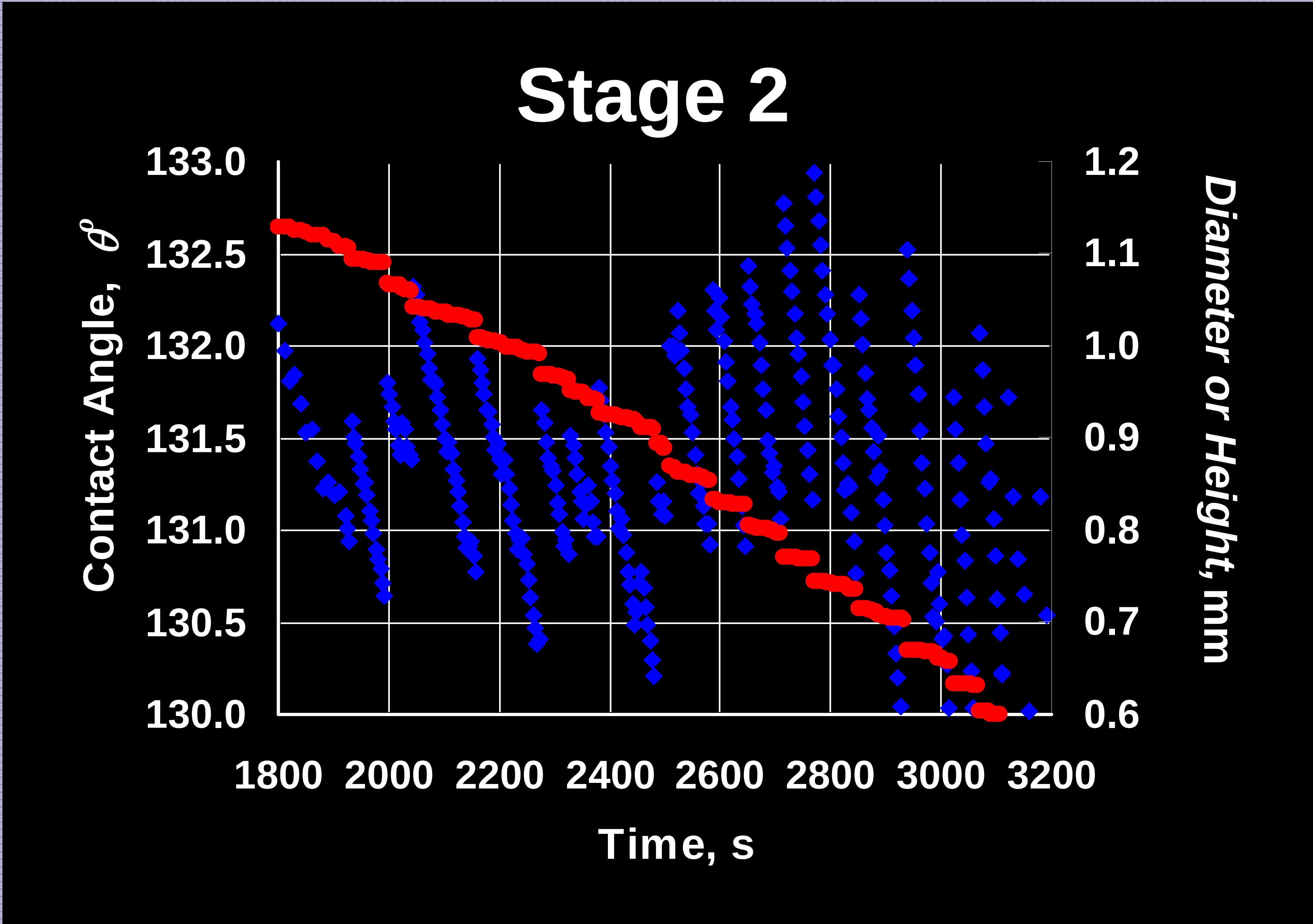

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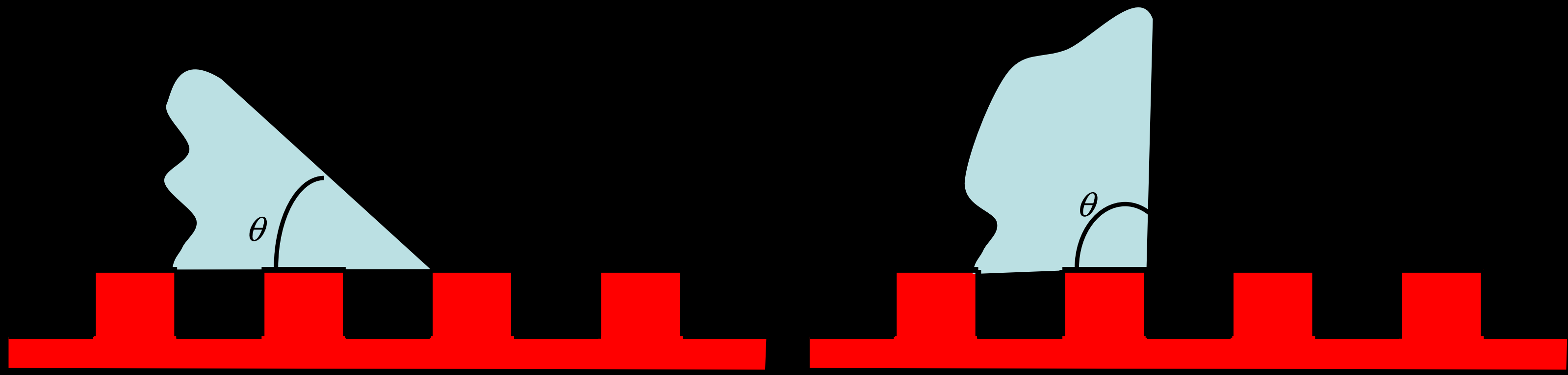

$$\Delta\theta = -\sin\theta(2+\cos\theta)\left(\frac{\Delta r_b}{r_b}\right)$$

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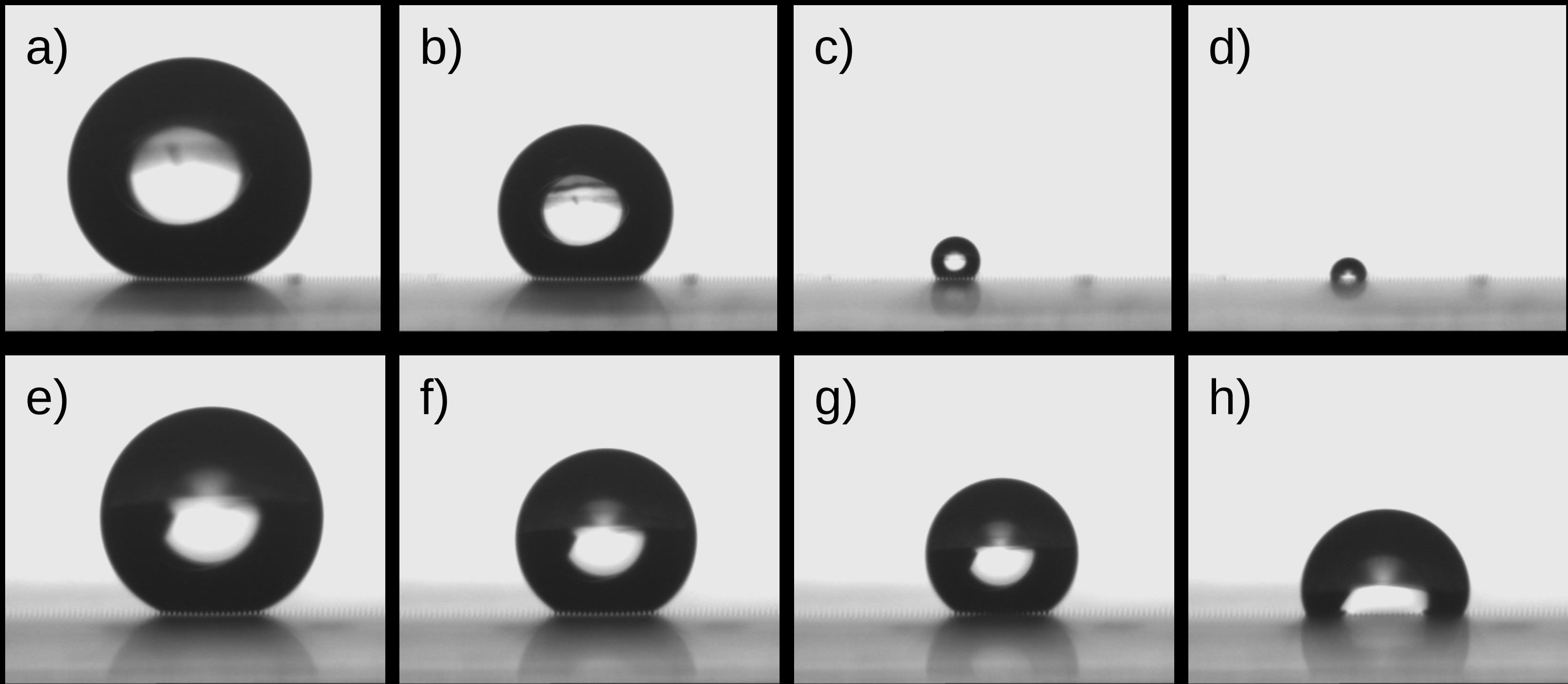
Drop Collapse



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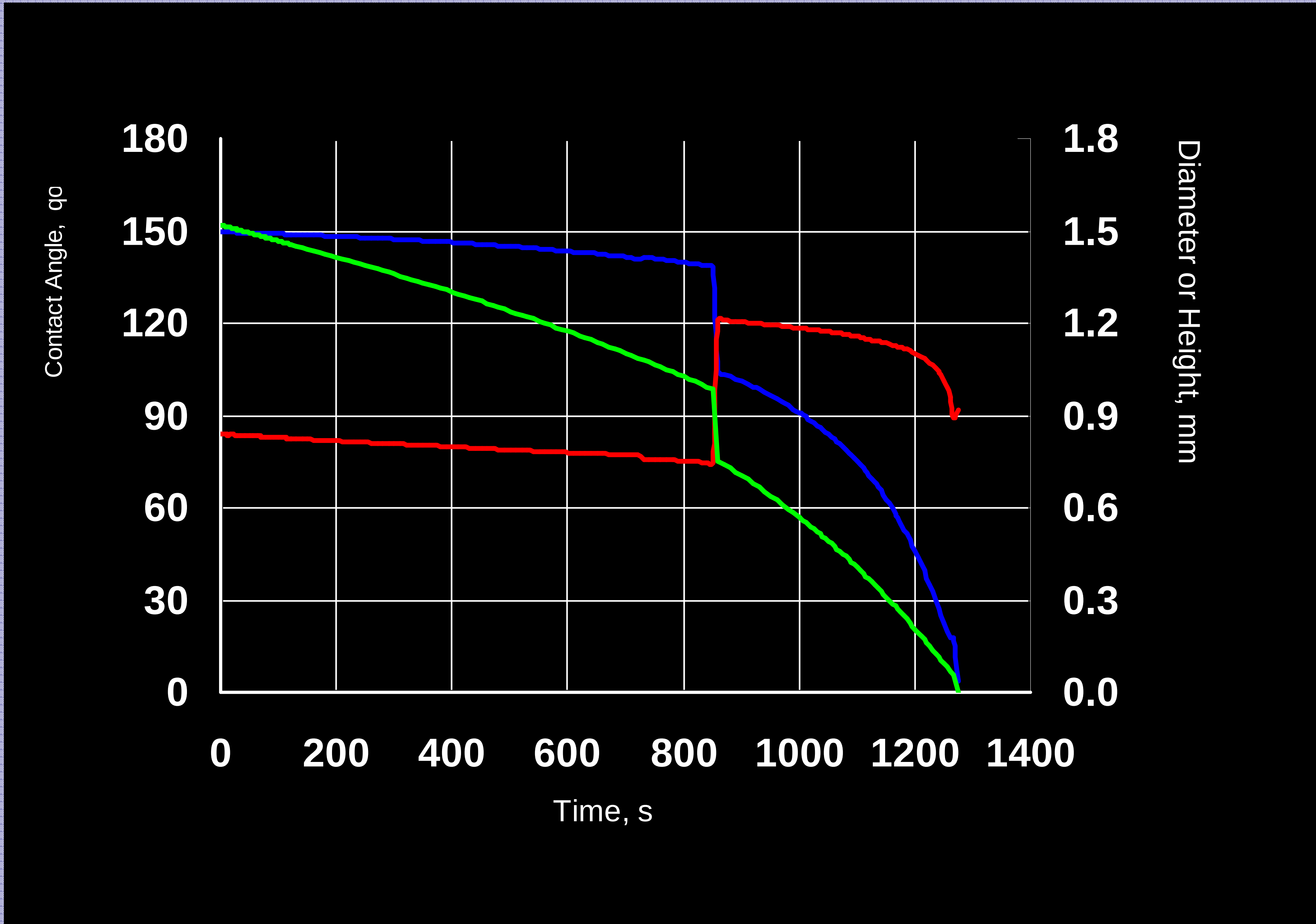

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Values of D calculated using two different approximations are very close to literature values, the cooling effect of the drop drying could not be calculated.

The Drying followed the predicted pattern initially

Despite this drops on Super-hydrophobic surfaces last longer (on leaves the volume is increased by collecting water over the whole surface).