

Natural Characteristics That Lead

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to **Superhydrophobicity**

Project ID

SBI168

Experimental Procedure

Paraffin CA Determination

- **Determined the contact angle (CA)** of a water droplet on a flat paraffin surface. This was the control experiment, and was also used to verify the experimental procedures. Figure 3 shows the experimental setup.
- **Analyze the pictures** taken for samples with water droplets using ImageJ and the Contact Angle Plugin for the software.^{8,9}
- **Compare the results** to the CAs measured by Ray and Barte.¹¹

Floret Microstructure Examination

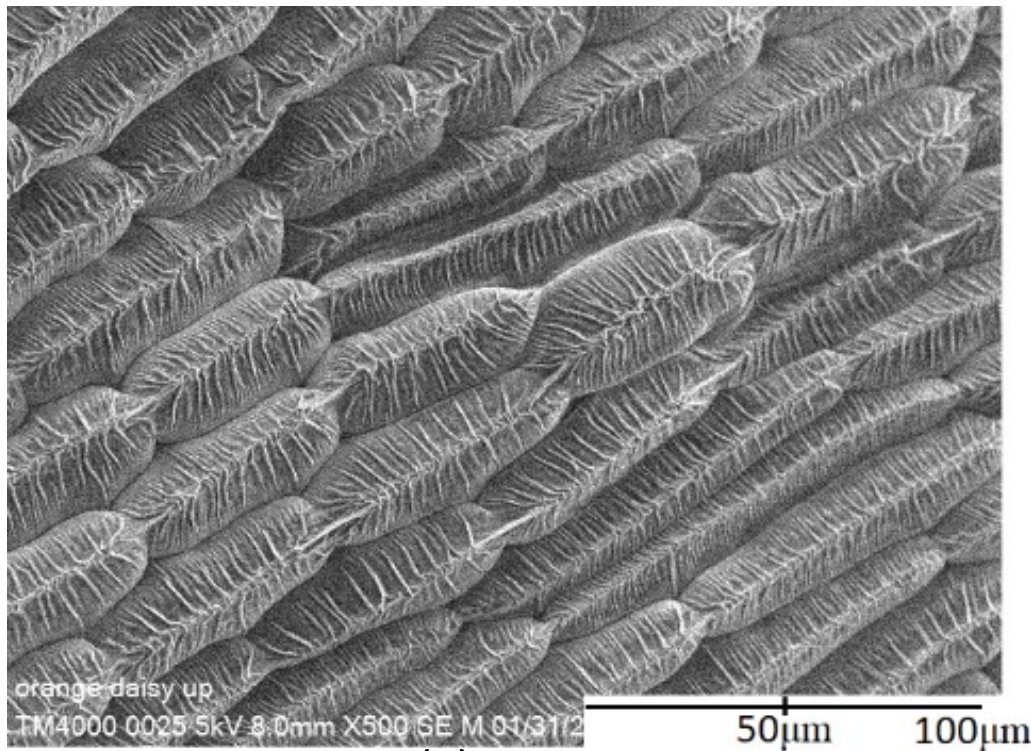
- **Take CA measurement** on surfaces of the following plants: orange daisy (Gerbera daisy, from the family Asteraceae), white daisy (Shasta Daisy from the family Asteraceae), red rose (Rosa 'Mister Lincoln').

Floret CA Measurement

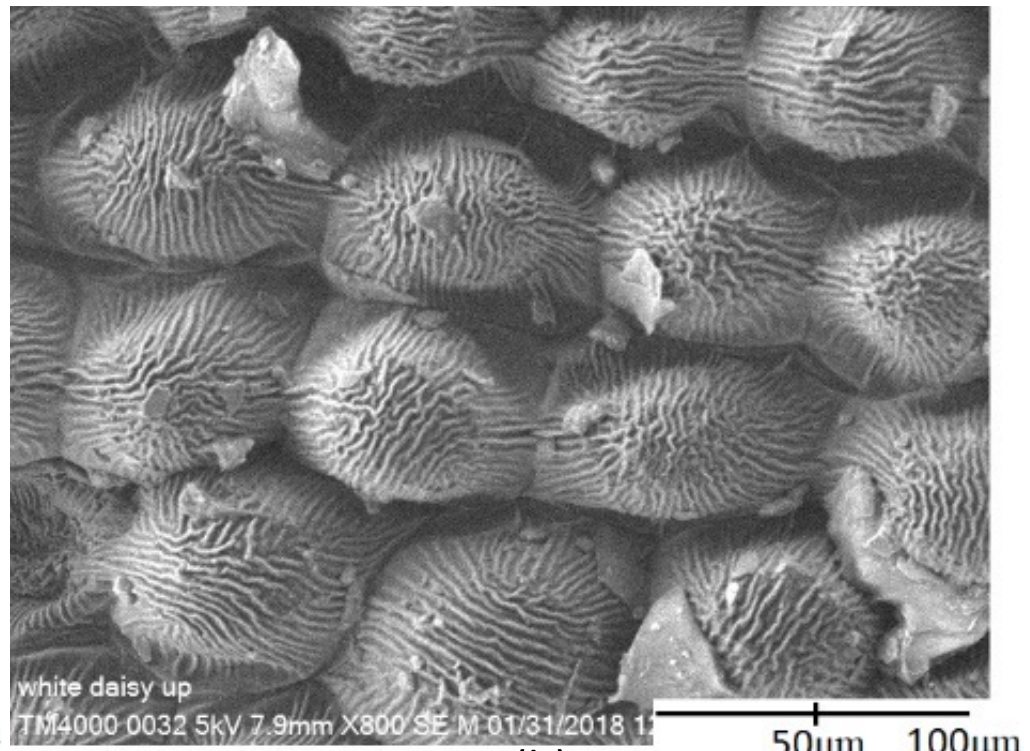
- **Examine the surfaces** of those three florets with high CAs under a SEM (Hitachi TM4000 PLUS Tabletop Microscope, 15 KeV).
- **Determine the dimensions of the hillocks** from the micrographs (shown in Figure 4).

Data Analysis

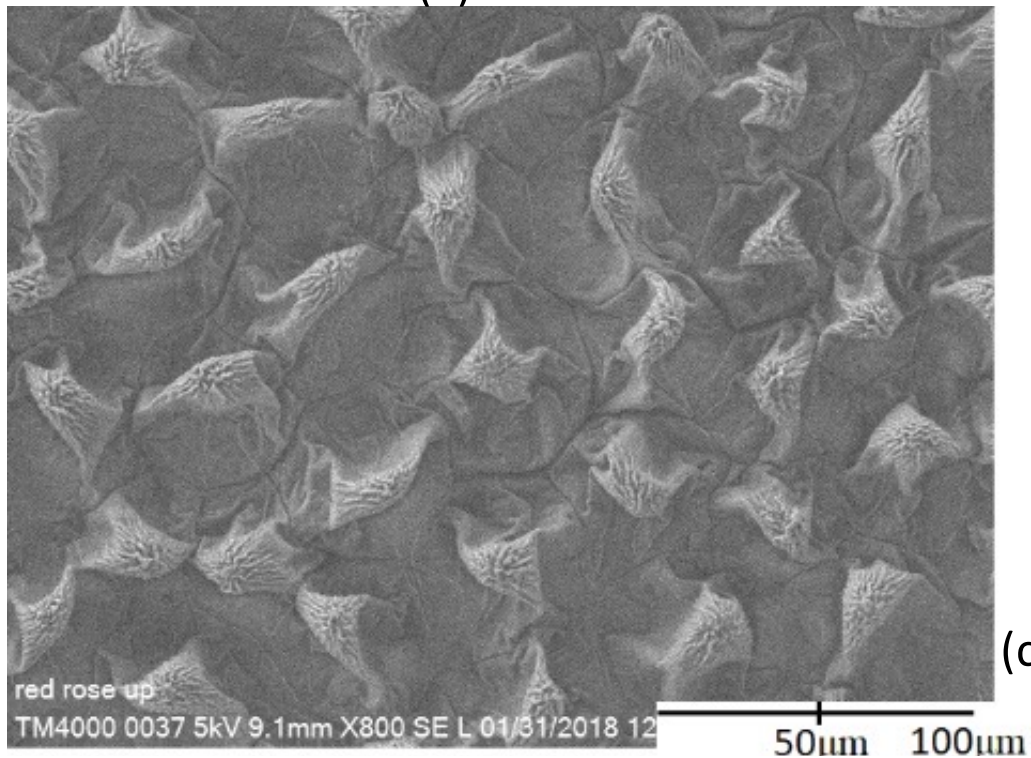
- **Utilize the experimental data** from the first three steps. Published CA and morphology data sets from the literature were also used to augment the experimental data.
- **Normalize** data from different sources.
- **Relate mid-width** of the papillae with the fraction of solid-liquid contact area (f_{SL}). The Cassie-Baxter equation was used to reflect the prediction for their relationship.
- **Graph and compare** the equation to the actual data points and their trend lines.



(a)



(b)



(c)

Figure 4. Three best images of the top side of the flower petals taken using the SEM.

(a) orange daisy (*Gerbera* Daisy, from the family Asteraceae).

(b) white daisy (*Shasta* Daisy, from the family Asteraceae).

(c) red rose (*Rosa* 'Mister Lincoln').

Hydrophobic prediction graphs

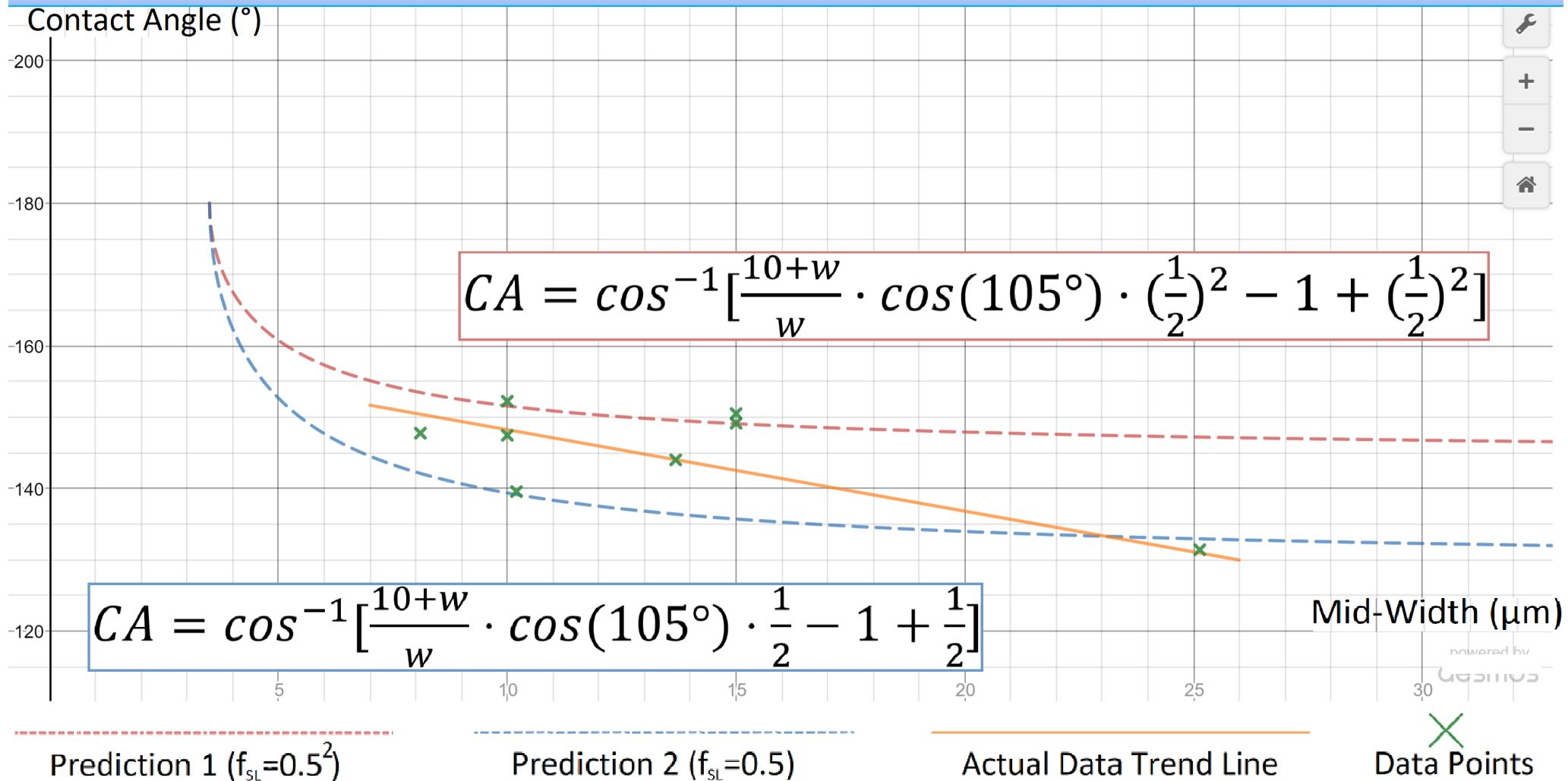
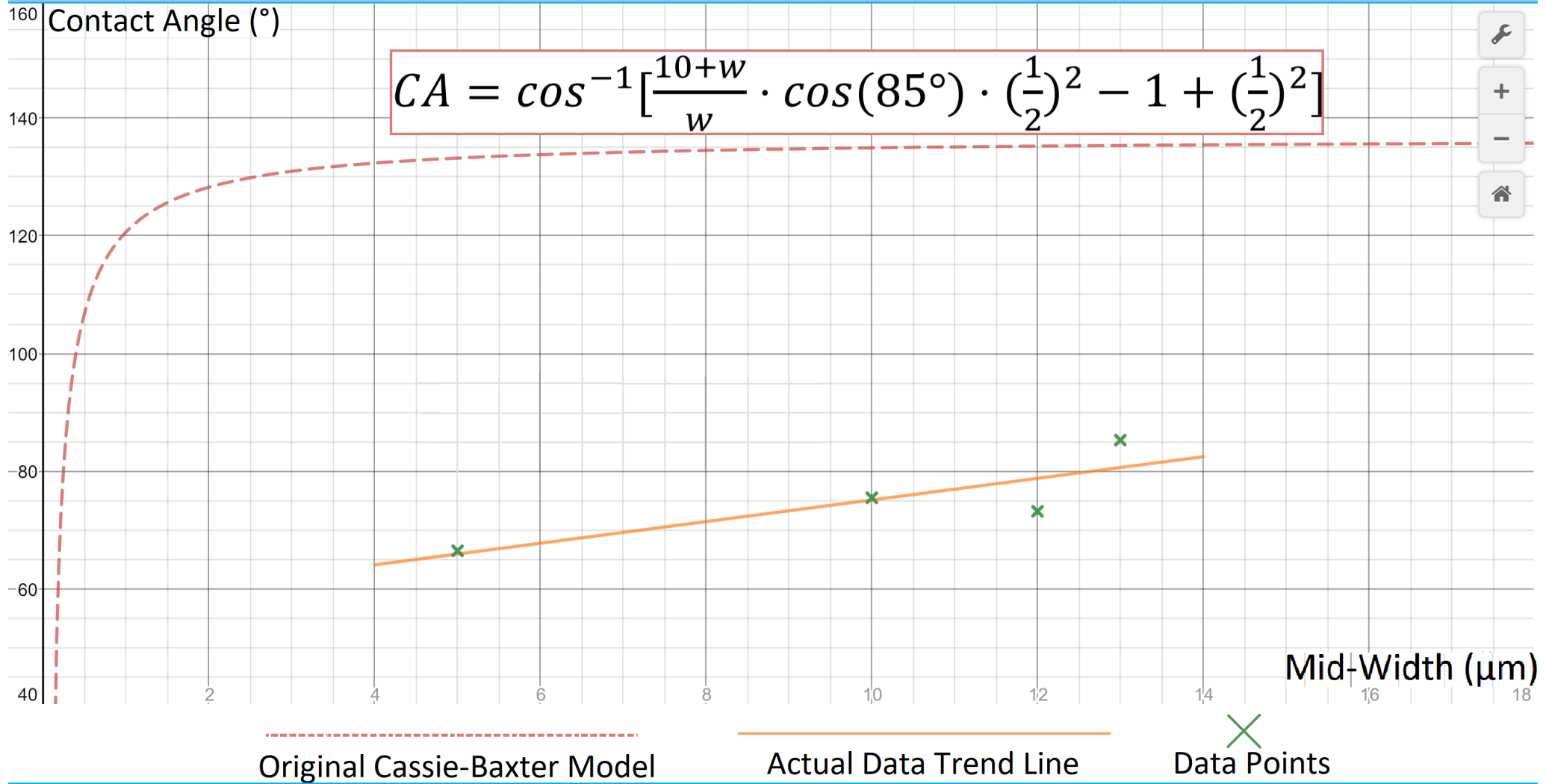


Figure 5. (a)

Hydrophilic prediction graphs



$$CA = \cos^{-1} \left[\frac{10+w}{w} \cdot \cos(85^\circ) \cdot \left(\frac{1}{2}\right)^2 - 1 + \left(\frac{1}{2}\right)^2 \right]$$

Figure 5. (b)

The Wenzel State of Wetting

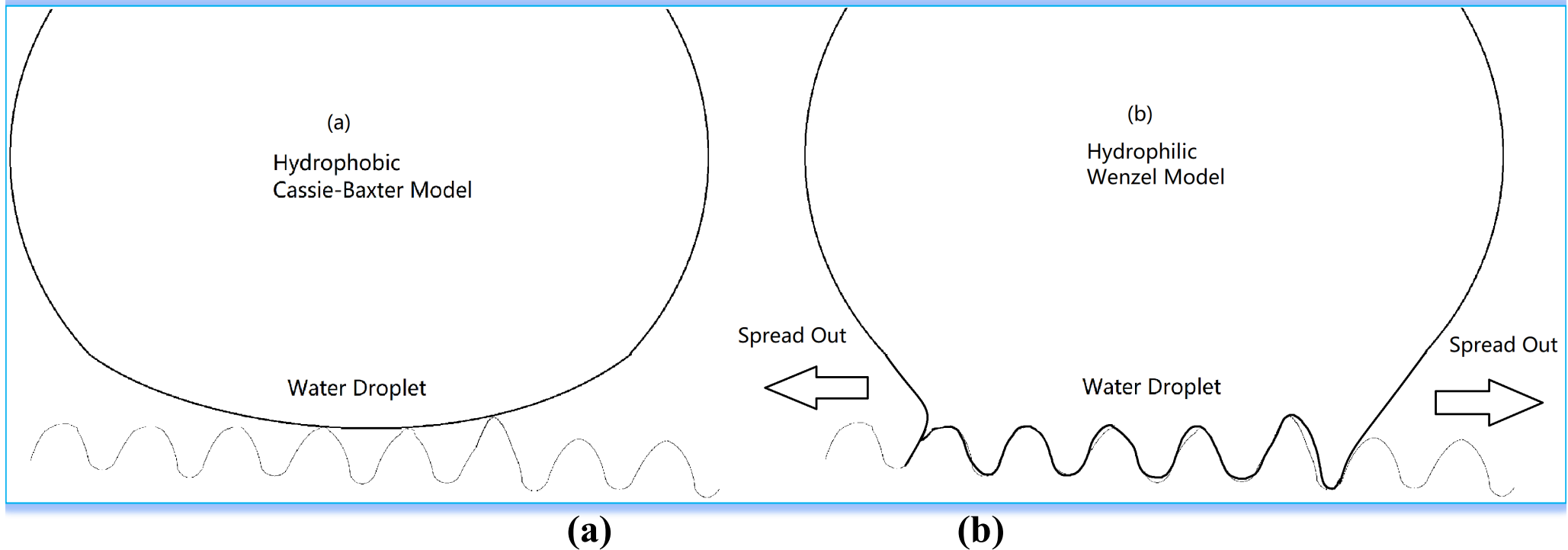


Figure 6 (a) the Cassie-Baxter state of wetting.⁶ Water stays outside the sunken spots. (b) the Wenzel state of wetting.¹⁰ Water goes into the valleys because the flat surface is hydrophilic.¹³ for a hydrophilic surface the Wenzel equation should be used. The Wenzel equation for hydrophilic surfaces is modified with the mid-width :

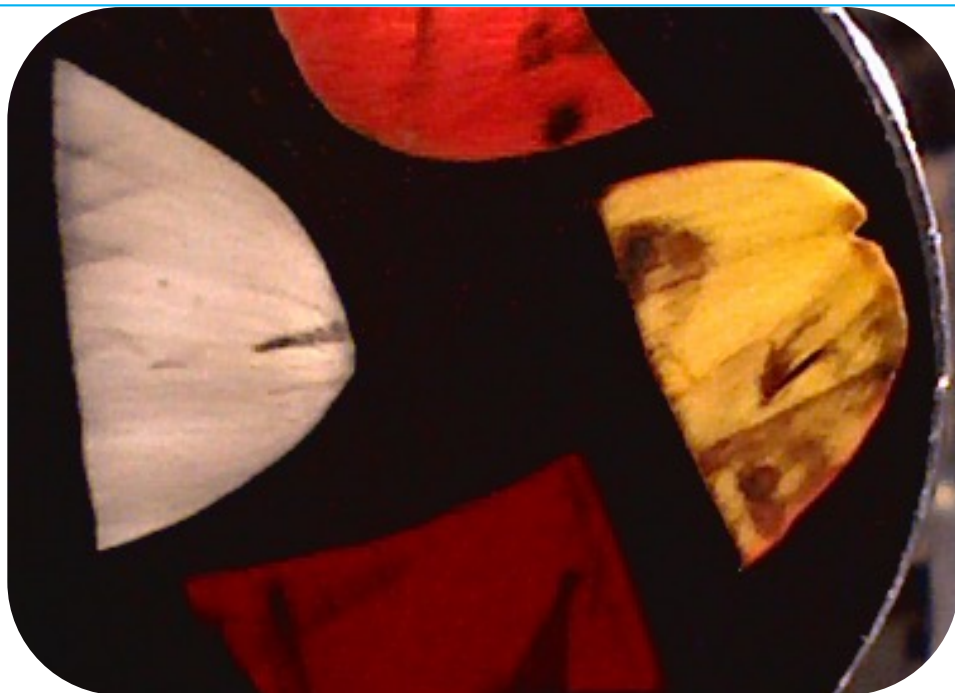
$$\cos\theta = \frac{10+w}{w} \cos 85^\circ \quad (2)$$



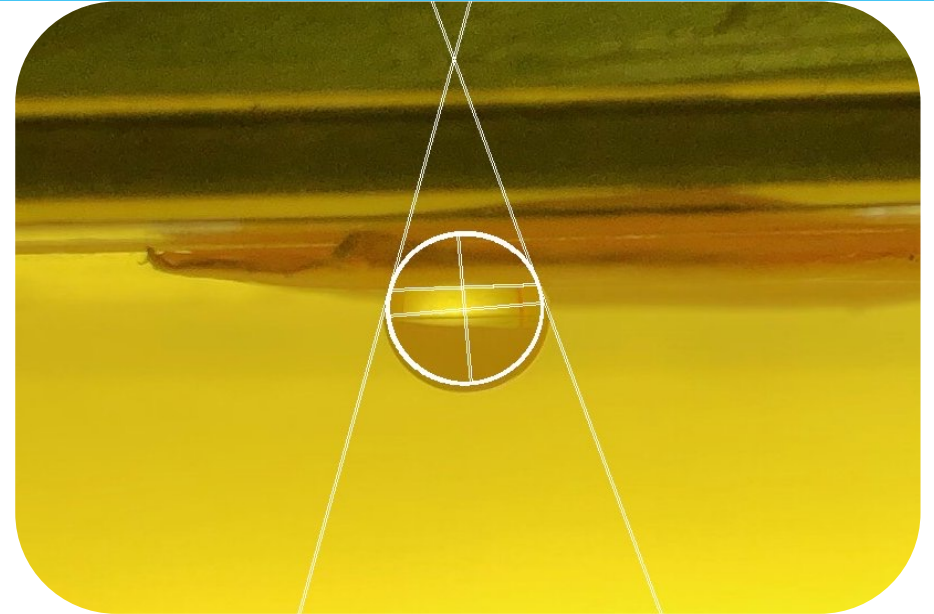
Water forming spherical droplets on a lotus leaf¹⁴



The author in a lotus farm



The flower petals under SEM



An analyzed picture of a water droplet on a rose petal