Teaching Activities for the Superhydrophobicity and Adhesion Observed in Rose Petals due to their Hierarchical Structure

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What is the Rose Petal Phenomenon?

Rose petal phenomenon is the ability of certain rough surfaces to have a high contact angle with water simultaneously with high adhesion (large contact angle hysteresis) with water (Fig 1).

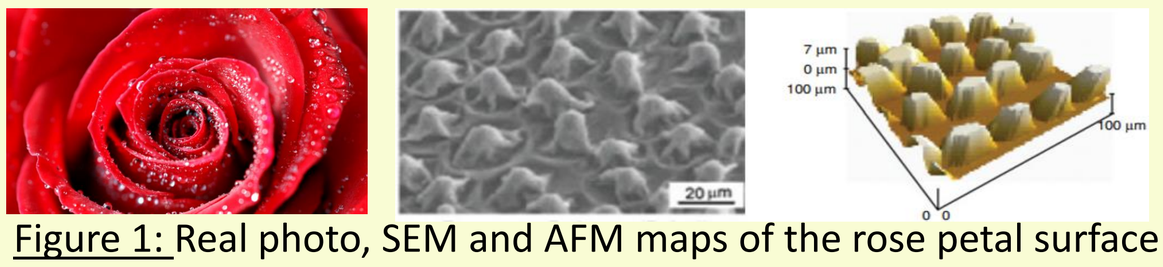

Figure 1: Real photo, SEM and AFM maps of the rose petal surface

Objective

This work suggests a proposal for the introduction of the rose petal phenomenon in Secondary Education for senior high school students through the educational reconstruction of the scientific content and the development of appropriate instructional materials and collaborative activities.

Materials & Methods

The scientific content for the rose petal phenomenon was identified through the corresponding section from Bhushan's (2012) book. The educational reconstruction was based on the MER model (Duit et al., 2012). It was also taken into account the two Big Ideas "Size-Dependent Properties" and "Forces and Interactions" of NSE from the book of Stevens et al. (2009).

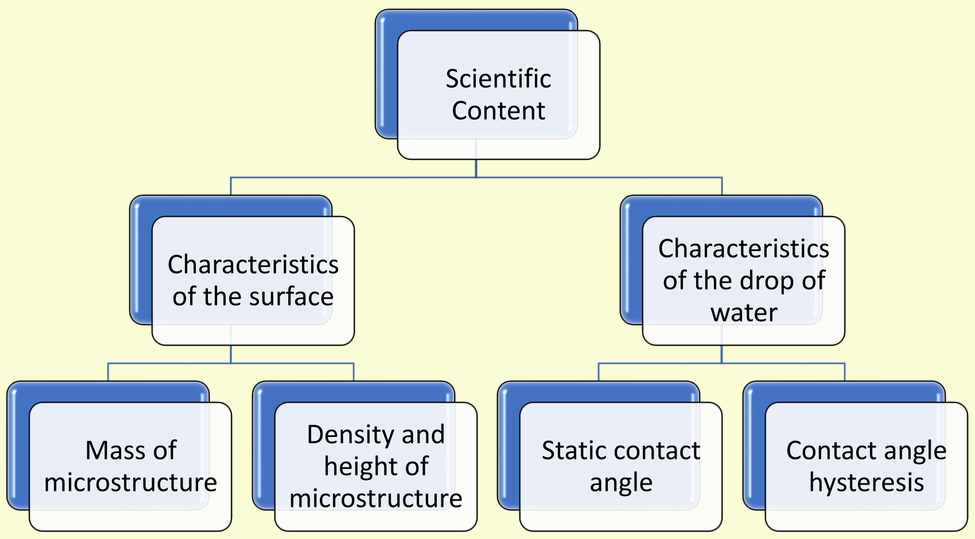

Figure 2: The scientific content of the Rose Petal Phenomenon

Instructional Goals

- Define the rose petal phenomenon
- Make measurements of the contact angle and the contact angle hysteresis of a water droplet
- Describe the wetting behaviour of different types of rose petals
- Differentiate the type of adhesion of two rose petals based on the contact angle hysteresis
- Predict the wetting model and adhesion of a man-made surface

Teaching Activities

Characterizing the rose petal: Students will study the variations in wetting and adhesion that two different rose petals present either dried or fresh with hands-on experimentation (Fig 3).

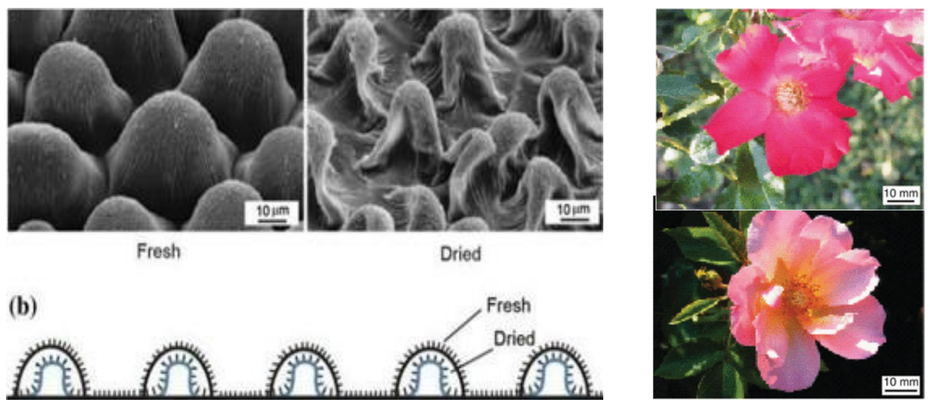

Figure 3: SEM pictures of fresh and dried rose petals (left) and two different types of rose petals (right)

Characterizing the water droplet: Through photos given to them and hands-on experiments, students will be introduced to how to measure the static contact angle and the contact angle hysteresis of a drop (Fig 4).

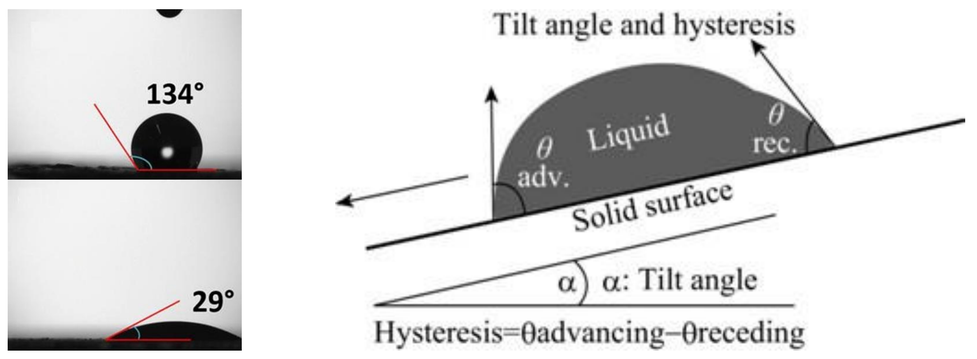

Figure 4: Measurement of static CA (left) and CA hysteresis (right)

Study of the hierarchical structure: Students will be acquainted with hierarchical structures and how different structures have different wetting models based on the difference on the characteristics of the surface (Fig 5).

Man-made surfaces mimicking the rose petal phenomenon: Students will be presented with pictures of man-made surfaces and based on the characteristics of each surface will predict the wetting model and adhesion and check their prediction by studying a drop on each surface (Fig 6).

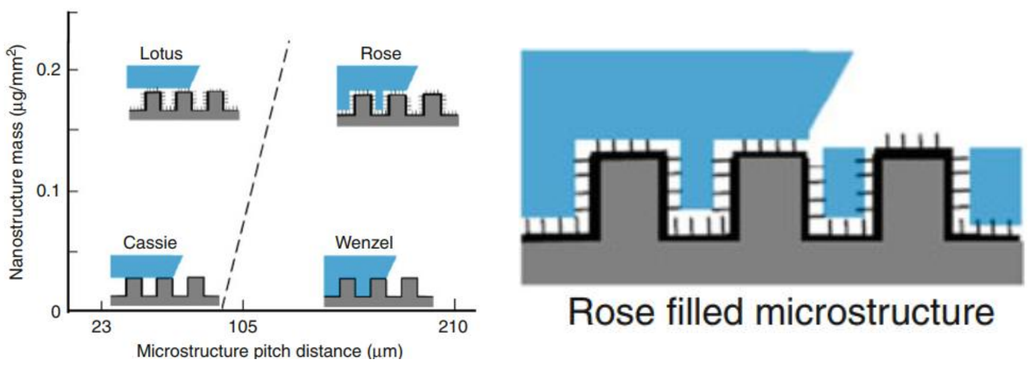

Figure 5: Wetting of different microstructures

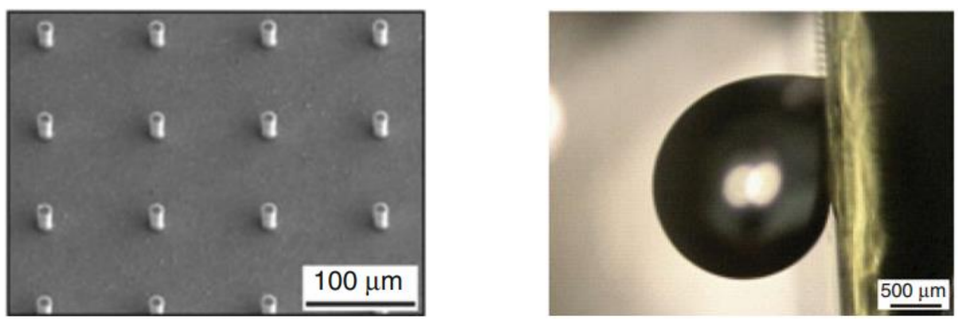

Figure 6: Hierarchical structure with 105 μm pitch

Conclusion

Through this work, students will be able to understand the different wetting that rose petals can show, study the characteristics of a drop on them as well as indicate and identify the same phenomenon on a man-made surface.

Acknowledgements

RESEARCH COMMITTEE
ARISTOTLE UNIVERSITY OF THESSALONIKI

The corresponding authors acknowledge the Research Committee of Aristotle University of Thessaloniki (RC-AUTH) for the financial support of the participation in the 11th Conference of the Balkan Physical Union (BPU11 Congress)