Dynamic Synthesis of Bamboo-Shaped Silicone Nanorods to Control Water Repulsion and Collection

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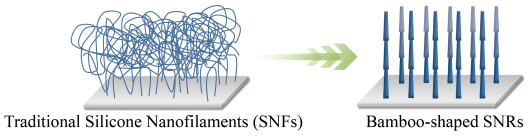
Design and synthesis of regular and morphologically controllable silicone micro and nanostructures have long been a topic of great interest in materials and surface science. Although there has been extensive research on the fabrication of ordered and uniform structures, most of the methods such as chemical etching and lithography are limited to long-term treatment under harsh conditions, hazardous chemicals, environmental impact, and high cost. Our research systematically investigates the synergistic influence of various growth parameters for silicone nanorods (SNRs) and proposes the dynamic Droplet Assisted Growth and Shaping (d-DAGS) strategy to achieve one-step synthesis and in-situ shape control of SNRs.[1] The periodic dynamic regulation of growth parameters, such as relative humidity, precursors, and reaction time, contributes to the fabrication of highly regular bamboo-shaped SNRs with an adjustable number of segments, which provides novel insights into the mechanism of the traditional chemical vapor deposition method and the "tip-growth" model. Compared with the conventional 1D silicone nanofilaments and wires, which are usually fragile and irregular due to their soft mechanical properties,[2] the bamboo-shaped SNRs have enhanced mechanical stiffness and, therefore, can keep growing into the straight ultra-long rods with super-high aspect ratio and perfect superhydrophobicity with nearly 180^{o} static water contact angle. Based on the strong chemical stability and water resistance properties, the versatility of bamboo-shaped SNRs is presented in the improvement of buoyancy, self-cleaning, and water harvesting. Meanwhile, the d-DAGS strategy promotes more possibilities to fabricate specially designed bamboo-shaped structures through the regulation of each independent, distinct segment. Further chemical modifications on the specific segments of the bamboo-shaped SNRs to endow them with unique physical and chemical properties are promising and will allow their applications to be extended to a broader range of fields.



[1] Kangwei Chen, Shanqiu Liu, Yuen-Yee Lau, Stefan Seeger, *Small*, **2022**, 18 (40), 2203820.
[2] Georg R.J. Artus, Stefan Seeger, *Adv. Colloid Interface Sci.*, **2014**, 209, 144.