Exploiting "micron" superhydrophobicity

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Superhydrophobicity, a property often observed in nature, is defined as surfaces exhibiting extreme high water contact angles (CA > 150°). The importance and potential applications of the superhydrophobic materials are immense and the research has been extensive. For instance, they are known for the self-cleaning, low-friction, and anti-fouling properties as well as their capabilities to inhibit snow adhesion, oxidation and current conduction. However, to date, the superhydrophobicity is only discussed at the macroscale. This is because superhydrophicity is assessed by the contact angles of a water droplet on a surface. Thus the phenomenon can only be discussed in terms of bulk materials. A confirmation of the superhydrophobicity at the smaller-scale will open up the possibility to miniaturize such materials and further expand the prospective applications. To tackle this, we explored the superhydrophobicity of the two particles with distinctive morphologies; these two particles constitute of same alkylated fullerene molecule but one possesses flaky surface (a) and the other is flat featureless disc (b). Although the morphologies are different among the two, both are superhydrophobic as bulk films (a and b). Superhydrophobicity is a product of nano/micrometer two-tier surface roughness where air is trapped at the interface. In another words, a particle should trap air at the interface if it is superhydrophobic. Since air is intrinsically poor thermal conductor, it will thermally insulate the particle. Such concept was elaborated by photothermally heating the shaggy particle in water and organic solvent via laser at 532 nm (c). The photothermal heating caused melting of the particle in water. On the other hand, the particle that was immersed in organic solvent did not melt; an indication of no air insulation and allowing heat to dissipate into the surrounding (c). It is important to mention that the featureless disc in water did not melt during photothermal process (d); therefore concluding that the disc is not superhydrophobic as an individual entity but they are superhydrophobic as a film (b).