Electronic Supplementary Material (ESI) for Green Chemistry.

Supplementary Information

Environmentally-safe and Transparent Superhydrophobic Coatings

Joseph E. Mates,[1†] Ramsey Ibrahim,[1] Alejandro Vera,[1] Stephen Guggenheim,[2] Jian Qin,[3] Debbie Calewarts,[3] Don E. Waldroup,[4] Constantine M. Megaridis[1*]

[1]Mechanical and Industrial Engineering, Univ. of Illinois at Chicago, Chicago, IL 60607, USA.

[2]Earth and Environmental Sciences, Univ. of Illinois at Chicago, Chicago, IL 60607, USA.

[3]Corporate Research and Engineering, Kimberly-Clark Corporation, Neenah, WI 54956, USA.

[4]Corporate Research and Engineering, Kimberly-Clark Corporation, Roswell, GA 30076, USA.

†Present address: National Research Council/Air Force Research Laboratory, Edwards AFB, CA 93524 USA.

*To whom correspondence should be addressed. E-mail: cmm@uic.edu

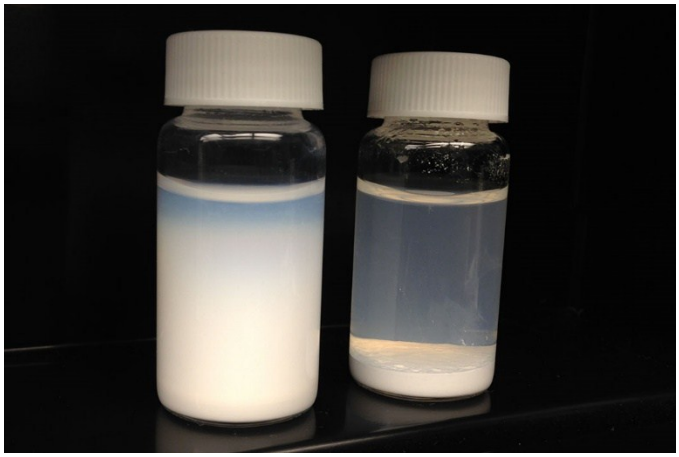

Fig. S1. 20 ml vials of sonicated 5 wt. % TiO_2 particles in water and left undisturbed for one month at room temperature (20 °C). The left vial contains 21 nm mixed-phase TiO_2 and maintained relatively uniform suspension throughout this prolonged period. A small portion of the larger particles separated out towards the bottom of this vial. Anatase (right) consisted of much heavier particles, which settled within the first hour of storage.

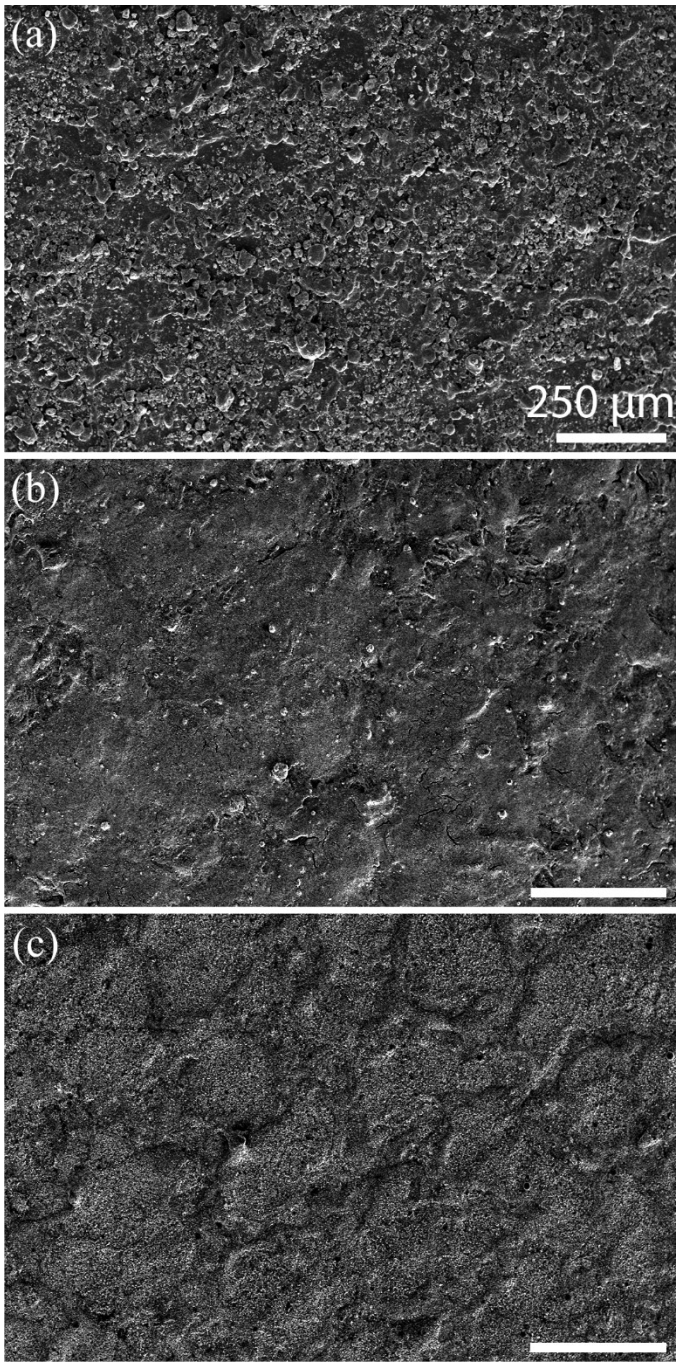

Fig. S2. SEM micrographs at low magnification (scalebar is 250 µm for all images) of (a) anatase, 21 nm mixed-phase, and 100 nm mixed-phase TiO_2 composites. The images serve to illustrate the textural self-consistent homogeneity of the composites, and the inherent morphological differences between them. (a) In anatase, the largest micron-size aggregates are observed, likely due to a greater affinity of the nanoparticles surface with the PE polymer backbone. (b, c) The mixed-phase composites form smaller insulated aggregates relative to anatase, with aggregate size being more dependent on initial nanoparticle size.

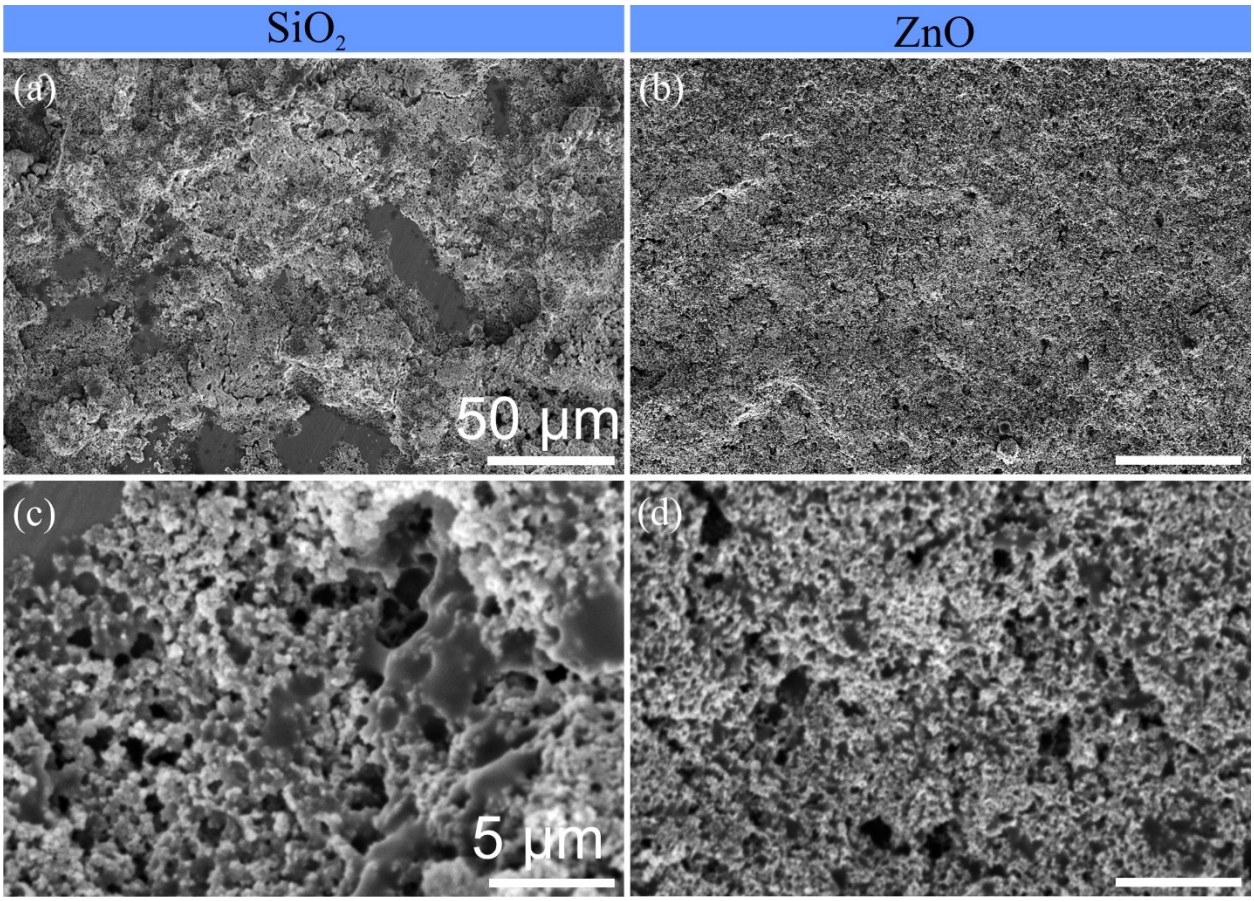

Fig. S3. SEM micrographs of SiO_2 (left column, a, c) and ZnO (right column, b, d) composites with PE. Morphology is similar to that of the TiO_2 + PE composites, albeit with reduced CA hysteresis, as demonstrated in Figure S4. Top row (a-b) in low magnification (50 µm scale bar), and bottom row (c-d) in high magnification (5 µm scale bar). A greater amount of smooth exposed PE (grey) is evident for the SiO_2 composite, although there are observable PE patches in the ZnO-containing composite.

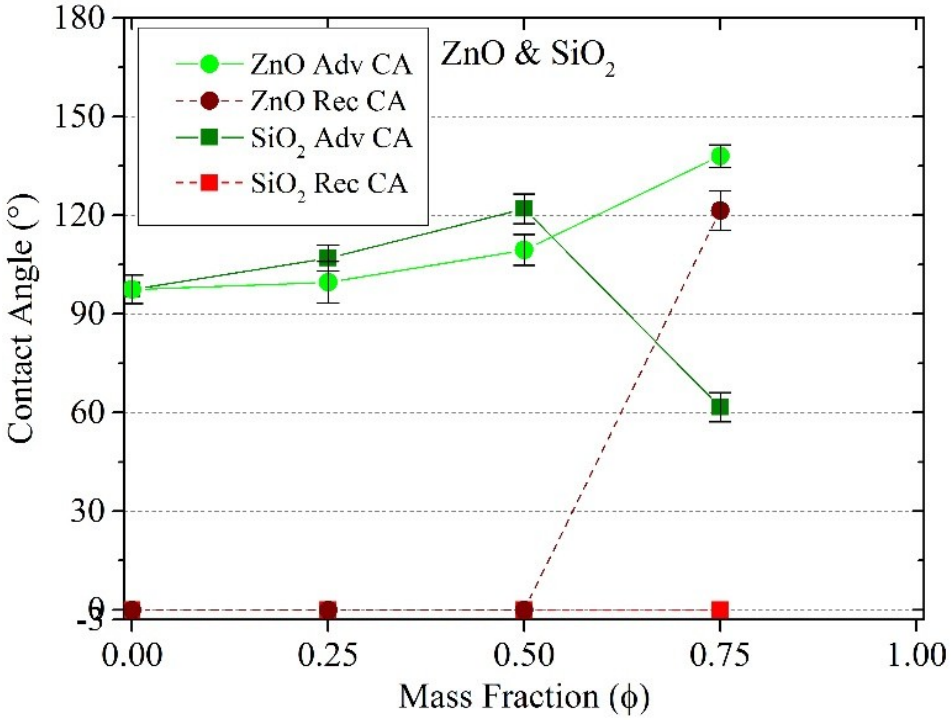

Fig. S4. Advancing and receding water contact angle (CA) for 5-15 nm SiO_2 and 40-100 nm ZnO composite coatings (with PE). None of the composites tested achieved superhydrophobicity, further strengthening the claim for a unique adsorption mechanism associated with nanoTiO_2.