Superhydrophobic Metal-Oxide Thin Film Coatings

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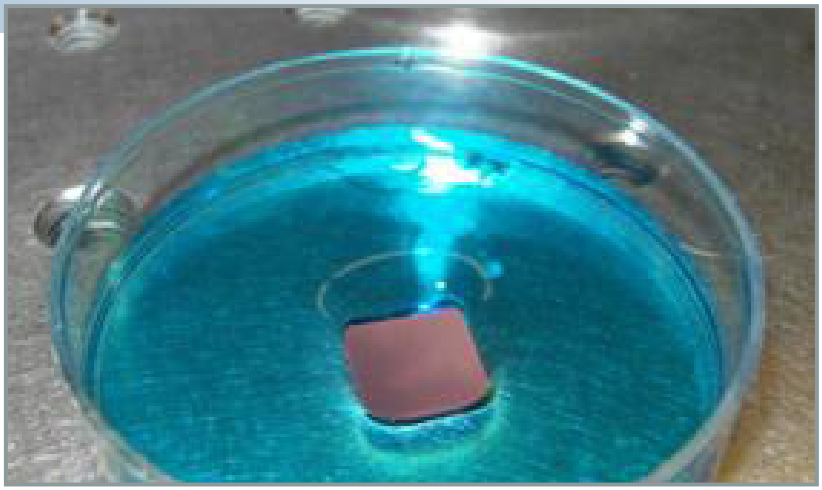

Technology Summary

Because of their numerous advantages and applications, considerable efforts have been expended to develop superhydrophobic (water repellant) coatings. However, traditional superhydrophobic coatings are soft in nature, with a Teflon-like surface chemistry that results in reduced adhesion and durability, and hence such coatings are not suitable for robust applications. In addition, the harsh chemical treatment processes used to create many of these coatings (e.g., use of chemical solvent mixtures) tend to degrade the physical properties of the underlying materials and create human health and environmental concerns.

By exploiting the properties of oxide materials, ORNL researchers have developed a new approach to creating exceptional superhydrophobicity in durable thin-film-based coatings that not only overcomes the previously described problems, but also provides very high levels of mechanical, thermal, and environmental stability. Testing has confirmed the following properties in coatings produced by this process.

- Superhydrophobicity (droplet contact angle > 170°)
- Rolling angle less than 1°
- High density and uniformity
- UV resistance
- Moisture tolerance
- Temperature tolerance (–40°C to 150°C)

The key to this invention is atomically bonding oxide materials that are chemically, thermodynamically, and environmentally stable (e.g., TiO_2 and Cu_2O) to the underlying substrate, thus providing durable, reliably bonded coatings. To generate a superhydrophobic surface, the nanostructured film created by this process is then coated with a chemically hydrophobic self-assembled monolayer such as a fluorocarbon or hydrophobic fatty acid. Because the overall process is not complex; uses nontoxic, inexpensive, abundant base materials; and is scalable, it offers a practical and cost-effective route to creation of a commercially viable new class of leading edge superhydrophobic products.

Advantages

- Nontoxic, inexpensive, abundant base materials
- Simple, flexible, scalable, and commercially accepted process
- Bonding materials not necessary
- No harsh chemicals used or produced
- Cost-effective

Potential Applications

- Durable, water repellant coatings
- Separation filters/membranes
- Electric/thermal insulation coatings
- Sensors exposed to the elements
- Corrosion inhibiting coatings
- Anti-biofouling/anti-icing coatings
- Superhydrophobic pattern printing

Patent

Tolga Aytug, Daniela Florentina Bogorin, Mariappan Parans Paranthaman, and John T. Simpson. *Superhydrophobic Films and Methods for Making Superhydrophobic Films.* Application in preparation.

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Related Technology

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