Superhydrophobic Transparent Glass Thin Films

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Technology Summary

Glass used in building materials (curtain walls), windshields, goggles, glasses, optical lenses, and similar applications must be durable and transparent. To meet this challenge, ORNL researchers have invented a method to produce durable, superhydrophobic, antireflective glass thin films for coating such surfaces.

Other processes exist for producing materials with the desired qualities, including superhydrophobic and antimicrobial surfaces; however, in most cases the resulting materials exhibit poor hydrophobicity or the properties are not durable and the surfaces require frequent maintenance and/or replacement. And some of the processes use toxic chemicals or produce toxic wastes, leading to disposal problems.

The basic approach used by ORNL begins with phase separating glass that is capable of spinodally decomposing when properly processed. The process is not limited to a particular phase separating glass or substrate, and a variety of deposition processes, including sputtering and chemical vapor deposition, may be used. No bonding agents are required. Once the coating has been applied and phase separated into a spinodal pattern (typically by heat treating), differential etching is used to remove one phase of the spinodal structure and partially remove the other. The resulting etched surface structure has a very porous and extremely small "funnel cake" or coral appearance when viewed with a scanning electron microscope. The final step is to apply a hydrophobic self-assembled monolayer to the etched surface. The various steps of the process can be modified to produce coatings tailored to specific applications. The result is a family of all-in-one coatings that exhibit the following characteristics.

- Superhydrophobicity (droplet contact angle > 170°)
- Optical transparency (> 95%) over a broad range
- Opacity to UV radiation
- Antireflectance (< 1%)
- High density and uniformity
- Durability (including scratch and crack resistance)

Advantages

- Not particle or nanoparticle based
- No bonding agents required
- Inexpensive, naturally abundant base materials
- Simple, scalable fabrication process
- No toxic substances used or produced
- Inherently self-cleaning
- Transparent
- Antireflective
- Improved product lifetime
- Substantial cost and energy savings

Potential Applications

- Any optical component exposed to wet conditions and subject to abrasion
- Optical lenses and lens filters
- Optical windows
- Windshields
- Goggles, eye glasses

Patents

Tolga Aytug, David K. Christen, and John T. Simpson. *Superhydrophobic Transparent Glass (STG) Thin Film Articles*. U.S. Patent Application 12/915,183, filed October 29, 2010.

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Related Technologies

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