Multi-Scale Block Copolymer Coating that Induces Hydrophobic Properties
Technology #18969

Applications

Multi-scale block copolymer coatings present a promising method to functionalize surfaces for self-cleaning properties. These transparent coatings can be applied in the post-processing manufacturing stage to achieve hydrophobic properties. As example, by coating a vehicular windshield surface with the coatings, water easily runs off the glass. In applications such as photovoltaics, the coating on the cover glass may be used to reduce the amount of water on the surface and minimize accumulation of debris that may block sunlight to the solar cells. Additional applications of the hydrophobic self-cleaning coatings are tactile surfaces, optical lenses, and microfluidic devices.

Problem Addressed

Self-cleaning surfaces and coatings have long been desirable for applications including vehicular windshields. The underlying principle of self-cleaning surfaces relies on the idea of hydrophobicity, alternately called the “Lotus Effect” after the water-repelling properties of a lotus leaf. These water repelling properties rely not just on the chemical properties of the constituent material but rather the physical structuring of the surface at the microscale or nanoscale. Current hydrophobic coating technologies attempt to add microscale topographical features onto the surface to trap air and thus repel water. Such technologies, like typical spray-on products, result in nondurable coatings which lose their self-cleaning properties after limited use and alter the optical properties of the material. Nanoscale patterns offer more durability and superhydrophobic properties at the cost of high fabrication expenses and manufacturing latency. This block copolymer nanomesh technology succeeds in innovating a low-cost and scalable method of functionalizing a surface with a durable, optically passive, and highly hydrophobic coating. By using self-assembling block copolymer materials with processing steps of spin-coating, annealing, and etching, the coating can achieve superhydrophobicity. Increased hydrophobicity may be achieved by iterating these processing steps, having multiple film layers which result in interpenetrating multiscale mesh structure, and optimizing parameters of polymer molecular weight, annealing conditions, and film layer thickness.

Technology

The principle of this nanomesh technology relies on similar concepts to the “Lotus Effect” with novel materials and processing methods. By altering the surface topography through the deposition of a multi-layer nanoscale pattern of silicon dioxide, the coating can impart hydrophobic properties. Leveraging numerical simulation and experimental insights into the orthogonal self-assembly of block copolymers, the coating’s constituent block copolymers naturally produce three-dimensional ordered cylindrical micro-domains without using complex techniques of layer-by-layer alignment or high-resolution lithographic templating. To achieve this polymeric ordered structure, the first block copolymer is spin coated onto the substrate. Next this first block copolymer is annealed and subsequently etched to produce the first patterned topographic layer. Then the second block copolymer is spin coated onto the first layer to then be annealed and etched again. In the repetition of these methods, a periodically patterned nanomesh surface results with the necessary roughness.
and topographic characteristics at the nanoscale to trap air and repel water. A hydrophobic chemical layer is finally applied. An additional characteristic is that the etched block copolymer pattern consists of a non-toxic and highly durable silica-like material with optical transparency.

**Advantages**

- Low-cost and scalable method for producing optically transparent hydrophobic coatings
- Highly durable coating
- Tunable hydrophobic properties

**Intellectual Property**

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**Categories For This Invention:**

- Materials
- Micro & Nanotech
- Nanomaterials
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**External Links:**

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