Scalable Manufacturing Of Superhydrophobic Structures In Plastics

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OTHER INFORMATION

CATEGORIZED AS

» **Biotechnology**
» Other
» **Materials & Chemicals**
» Polymers
» Thin Films

RELATED CASES

2015-141-0

BRIEF DESCRIPTION

Superhydrophobic surfaces that repel liquid have found a multitude of applications due to their self-cleaning and antibacterial effects, but are often highly surface selective and difficult to produce. Researchers at UCI have developed a new method to reliably mass produce universal superhydrophobic surfaces in a simpler and more cost effective manner.

FULL DESCRIPTION

Superhydrophobic surfaces are surfaces which, due to their inability to interact with liquids, are highly resistant to wetting. This liquid aversion leads to a host of interesting properties, perhaps most notably making the surfaces self-cleaning and antibacterial. Self-cleaning behaviors, which help to prevent the spread of diseases, have landed superhydrophobic surfaces an important role in health applications, while the antibacterial nature makes them suitable for inclusion in biomedical devices. Several everyday objects, such as boats, solar cells, and windshield wipers also benefit from the low liquid adhesion of superhydrophobic materials.

There are currently two main methods for producing superhydrophobic surfaces. The first relies on covering a surface with a superhydrophobic chemical coating. This method is highly selective as the chemical coating will only bind to certain surfaces. Additionally, the coating can wear off, destroying the superhydrophobicity of the surface and exposing the surrounding environment to possibly harmful chemicals. The second method, rather than relying on chemical modification, instead modifies suitable surfaces structurally to impart superhydrophobic behavior. These methods include processes such as directed etching and nanoparticle self-assembly, and are complex, time-consuming, and therefore ultimately difficult to use for large-scale production.

To solve these safety concerns and production limitations, researchers at UCI have developed a simple method for large-scale fabrication of structurally superhydrophobic surfaces. The process consists of depositing metals onto an industrial-sized sheet of shrink film as it is continuously rolled from one holder to another; this method is called roll-to-roll manufacturing. Once heated, the shrink film contracts, causing the metal coatings to generate structural features that are superhydrophobic. These structured films, cut to any desired size and shape, are then used to imprint an inherently hydrophobic material (such as silicone or plastic), resulting in a superhydrophobic plastic surface. As the superhydrophobicity is purely structural in nature, the resulting films do not suffer from the degradation seen in chemical coatings. Additionally, their direct deposition onto large rolls of film makes this technique relatively simple and highly compatible with mass production.

ADVANTAGES

§ Wide range of applications, from medical devices to solar cells

§ Not prone to degradation or leeching effects of chemical coatings

§ Simpler than other structurally-based superhydrophobic surfaces

§ Scalable to mass production via the roll-to-roll platform

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,427,331	10/01/2019	2015-141

STATE OF DEVELOPMENT

This method is an extension of an existing invention from this group, scaled up to allow for roll-to-toll manufacturing. The researchers have previously established that metal deposition onto small shrink films does generate superhydrophobicity, and that these structures can successfully be used to cast superhydrophobic features onto plastic surfaces. The resulting surfaces were ~ 1in x 1 in.

Currently, they are testing the compatibility of this method with roll-to-roll manufacturing in two separate ways.

(1) Metal deposition. They are currently testing the deposition of roll-to-roll compatible metal (silver and copper) onto shrink films. They estimate that it will take another 1-2 months for this scale-up process to be optimized.

(2) Imprinting onto plastics. For large-scale production, an intermediate "cast" of the superhydrophobic metal films must be made, which can then be transferred to a hard plastic also via the roll-to-roll platform. Researchers are currently testing the epoxy ormocer as this intermediate, a process that they project will take a few months to perfect.

RELATED MATERIALS

» SCALABLE MANUFACTURING OF SUPERHYDROPHOBIC STRUCTURES IN PLASTICS United States Patent Application 20160158969 - 06/19/2016

» Roll-to-Roll, Shrink-Induced Superhydrophobic Surfaces for Antibacterial Applications, Enhanced Point-of-Care Detection, and Blood Anticoagulation. - 12/10/2015

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