Process for the Fabrication of Nanostrucured Arrays on Flexible Polymer Films

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OTHER INFORMATION

CATEGORIZED AS

- **Biotechnology**
  - Health
- **Environment**
  - Sensing
- **Engineering**
  - Engineering
- **Materials & Chemicals**
  - Biological
  - Chemicals

BRIEF DESCRIPTION

The technology is a process for making arrays of nanostructures on polymer films.It features a two step process for creating thin polymer films with unique optical and wetting properties that can be used for coating both planar and curved surfaces.It is possible to implement this process in a mass fabrication process over large areas.

FULL DESCRIPTION

This invention is a fabrication process for arrays of nanostructures (e.g., nanocones) on flexible polymer films. This fabrication process allows for the nanocone arrays to be created on a large scale (e.g., 10-100 sq. inches) on a flexible polymer film via a two-step process. The first step consists of self-assembling a layer of polymer microspheres or nanospheres on a different polymer film. The second step consists of the simultaneous differential etching of the polymer spheres and film to create the nanostructured surface. The resultant nanocone arrays can then be coated by an ultrathin metal, polymer, oxide, or semiconductor film or nanoparticles. The resulting nanostructured surfaces have unique optical and wetting properties, and the thin films are flexible enough to coat curved or convoluted surfaces.

Arrays of nanostructures organized on surfaces are highly interesting because they can exhibit unique surface properties such as structural iridescence, anti-reflectivity, superhydrophobicity, enhanced catalytic activity and coupled plasmonic optical resonances.These nanostructured surfaces can be potentially implemented as essential components in a variety of important application devices including biosensors, anti-reflective coatings, solar panels, self-cleaning surfaces, and bactericidal surfaces. There is an unmet need for an inexpensive, simple, rapid, and scalable technology to functionalize large surface areas with nanostructures in the areas of medical diagnostics, energy industries and military industries -- even potentially for everyday objects (e.g., car, clothes). Methods that utilize “top-down” fabrication such as focused ion beam etching and e-beam lithography can be used to create metallic, semiconductor and oxide nanostructures with precise control, but are costly, relatively slow and limited in total obtainable structured area. Additionally, objects with curved surfaces or complex shapes cannot be used. The UCI researchers have developed a new two-step fabrication process for creating nanostructure arrays on thin polymer films that is easy to implement, inexpensive, versatile, and fast.

SUGGESTED USES

- The nanostructured thin films can be incorporated into biosensors, anti-reflective coatings at visible and near infrared wavelength, self-cleaning surfaces, solar cells, LED displays.

ADVANTAGES

- Faster and less expensive that the nanofabrication process based on focused ion beam (FIB) etching
- Faster and more robust than current lithographic techniques
- Resultant nanostructured polymer films can be used for coating any given object regardless of shape

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,006,085	06/26/2018	2014-264

STATE OF DEVELOPMENT

To date, a prototype of the invention has been developed successfully for the fabrication of nanocone arrays, and the optical and wetting properties of these surfaces have been characterized. Precise control over the diameter and surface density of the nanocones can be achieved and has been demonstrated. Preliminary experiments show that it is also possible to similarly fabricate other structure types, such as nanocups and nanopyramids.

LEAD INVENTOR

- Composites
- Nanomaterials
- Polymers
- Thin Films

Medical

- Diagnostics
- Research Tools
- Screening
- Therapeutics

Nanotechnology

- Materials
- NanoBio
- Tools and Devices

Sensors & Instrumentation

- Biosensors
- Medical

RELATED CASES

2014-264-0

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RELATED MATERIALS

» Mana Toma, Gabriel Loget and Robert M. Corn, "Fabrication of Broadband Antireflective Plasmonic Gold Nanocone Arrays on Flexible Polymer Films" Nano Lett., 13 6164-6169 (2013).

» Mana Toma, Gabriel Loget and Robert M. Corn, "Flexible Teflon Nanocone Array Surfaces with Tunable Superhydrophobicity for Self-Cleaning and Aqueous Droplet Patterning" ACS Appl. Mater. Interfaces, 6 11110-11117 (2014).