Controllable hydrophobicity in azopolymers via surface relief gratings

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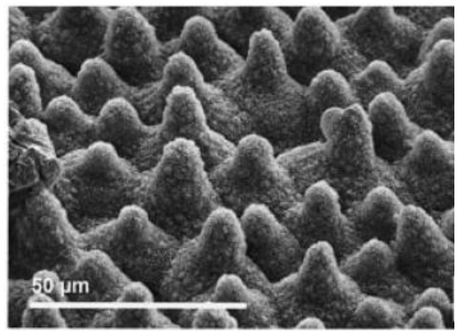
Motivation

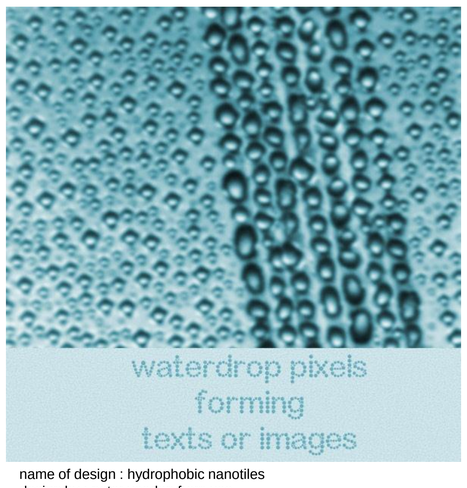
Inspired by the topology of the Lotus leaf, that naturally have a superhydrophobic surface, we used laser light to structuring polymeric surfaces.

Nelumbo Nucifera



Micromorphological characteristics of water-repellent leaf surfaces.

Purpose



name of design : hydrophobic nanotiles
design by : peter yeadon from usa
http://www.designboom.com/contest/view.php?contest_pk=2&item_pk=98&p=3

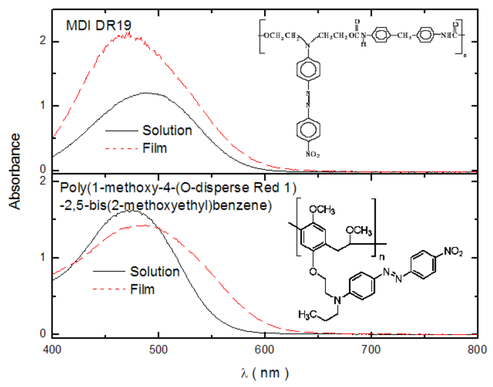
We propose the use of Surface-Relief-Gratings mechanism to create microstructures in azopolymeric films, aiming to produce controllable hydrophobic surfaces for applications in devices with capability to control the flow of liquids.

Introduction

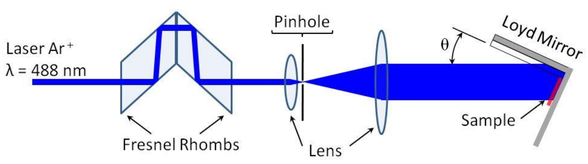
Surface-relief gratings (SRG) are formed when a film of azopolymer is exposed to an laser interference pattern, as a result of large scale molecular migration. Such gratings are formed due to the interaction of the molecule dipole with the electric field gradient, which results in the movement of the molecule. Besides, the photoinduced *trans-cis-trans* isomerization of the azo chromophores facilitates this movement.

Samples studied

We used the polymers MDI DR19 and Poly(1-methoxy-4-(O-disperse Red 1)-2,5-bis(2-methoxyethyl)benzene), whose molecular structure (monomer) is shown in the inset of the figure.. The UV-Vis absorption spectra of a chloroform solution (black) and film (red) are presented in the figure to the right for the samples studied.



Methodology

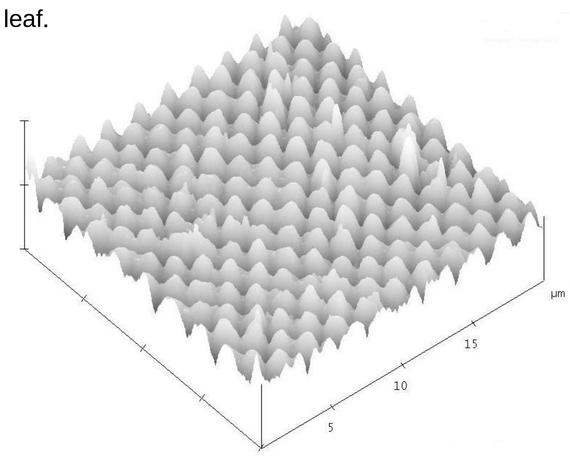


The films were exposed to an interference pattern generated by a linearly p-polarized Argon ion laser at 488 nm, with an irradiance about 70 mW/cm^2 for about 50 min.

Gratings with period from 1.0 to 3.5 µm have been recorded by adjusting the writing angle.

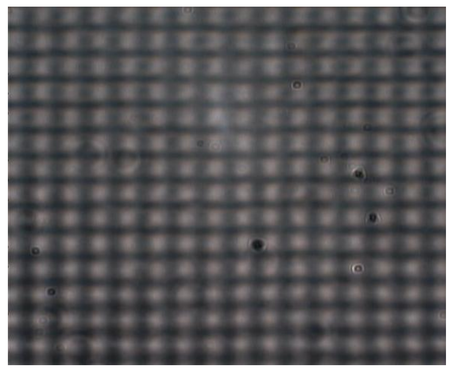
Results

The microstructured surface acquires the shape showed below, where we can observe a topology similar to that of Lotus leaf.



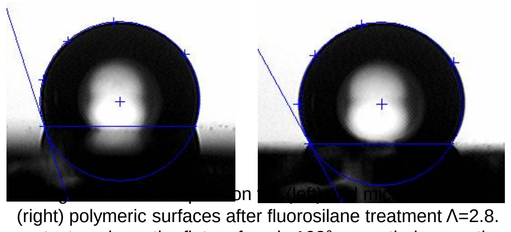
Atomic force microscopy: 3-D topography image of the surface relief gratings on a MDI DR19 film.

Λ= 2 µm



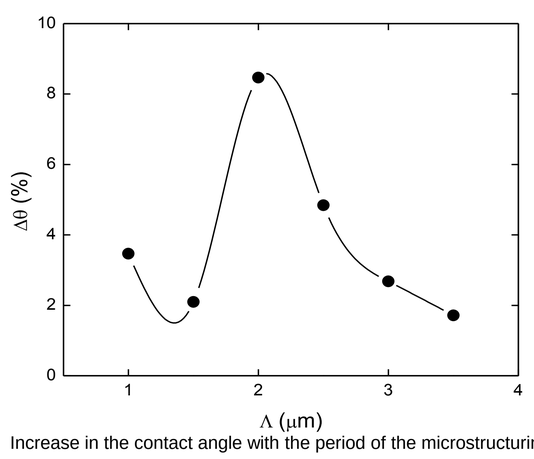
Λ= 3.5 µm

Fig. 3 presents optical microscopy pictures of microstructures with periodicity Λ= 2.0 and Λ= 3.5 µm respectively.



(right) polymeric surfaces after fluorosilane treatment Λ=2.8. contact angle on the flat surface is 108°, nevertheless on the microstructured surface, the contact angle is 118°, corroborating an increase of 10°.

A study on the wettability was carried out measuring the contact angle on flat and microstructured surfaces. The difference between these angles was calculated for each period of surface microstructures produced. The results reveal a higher increase of the contact angle for microstructures with period of approximately 2.0 µm. The wettability can be related with depth and width of the structures, that is corroborated by increase contact angle to Λ= 2.0 µm.



Increase in the contact angle with the period of the microstructuring.

Summarizing

This technique provides several advantages in comparison to other standard methods, such as the use of CW laser and the possibility to produce a larger microstructured area. A further advantage of microstructures produced in this way is the reversibility of the process.

Acknowledgements

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