CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
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Project Number
35489

Project Title
Achieving Super Hydrophobic Surfaces as Water Repellent Materials by Molecular Assembly of BCP and Plasma Dry Etch

Abstract

Objectives/Goals
The superhydrophobic surface as water repellant materials has great interest due to its self-cleaning function. The purpose of my experiment was to explore the uses of nano-materials, such as block copolymer and the plasma etch method to create the geometrical nano-structure on a silicon or glass substrate and then use the self-assembly of monolayer (PS-OH or PDMS-OH) to chemically modify the surface to achieve a superhydrophobic surface. The superhydrophobic surface can be used for many applications and to find a much cheaper and effective way of doing it.

Methods/Materials
1) Polished 150 mm (6#) diameter silicon and quartz wafers;
2) 99.8% toluene used as solvent for polymer;
3) Mono-hydroxyl-terminated polystyrene (PS-OH) (Molecule Weight Mn = 3700 g/mol) 1% Weight to weight (w/w) PS-OH in toluene;
4) Poly (styrene-b-dimethylsiloxane) (PS-b-PDMS) diblock copolymer (Mn=13500-b-4000). 1% PS-b-PDMS in toluene

Results
After being chemically modified with these nano-structures, and through multiple trials, the surfaces show a super-hydrophobic surface. This type of surface can be very helpful because it cause any type of liquid that falls on it, to immediately run off of the surface of the application, and leaving no traces of water behind. In addition, the contact angle of the surface of the wafer was able to gain additional 30 degrees, making it even more greater than the average super hydrophobic surface by 20 degrees!

Conclusions/Discussion
The conclusion I came to was by applying a nano-material of directed self-assembly onto a silicon or quartz wafer, it can form a super-hydrophobic surface with a greater contact angle, causing the water to be able to fall off more easily than just a flat surface. Using nano-materials and the process of it is a much more cheaper and effective way than the traditional coating methods, and it can last longer as it is an etching, in addition to the object with the super hydrophobic surface being able to automatically self-clean itself every time.

Summary Statement
Creating a super hydrophobic nanostructure surface to be used as a self-cleaning and protecting material for various applications.

Help Received
Used lab equipment under the supervision of Dr. Peter