Usage of Fomblin Y to Improve Water Repellence of Surface Coatings

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Background

- Fluoro Decyl POSS (FDP) has a high potential for applications in preventing both ice build up and chemical contamination. This is because FDP is water repellant. This is due to it's high amount of fluorination. Theoretically, adding FDP to coatings can be further improved by reducing the amount of crystal structure and making them more amorphous.

Question

Can adding Fomblin Y to FDP solutions used for dip coating decrease crystallinity and thus increase hydrophobicity?

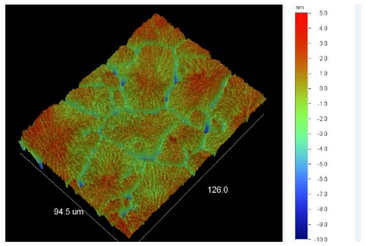
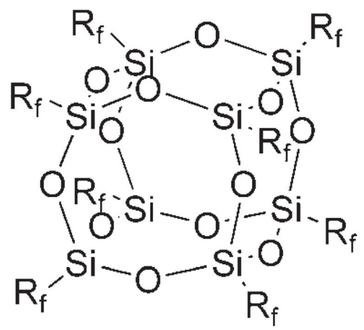


Figure 1: The blue regions represent "canyons" in the crystalline surface that water can fall into, making it harder to remove.

Coating Components Tested



FD $CH_2CH_2CF_2CF_2CF_2CF_2CF_2CF_2CF_2CF_3$

Figure 2: Fluoro Decyl POSS is a silicon oxide cage with a long, fluorinated carbon chains on each silicon atom, for eight total.

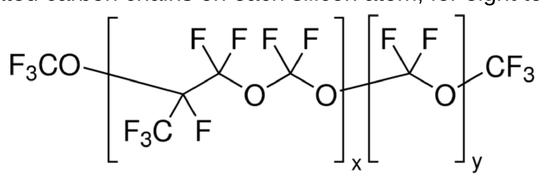
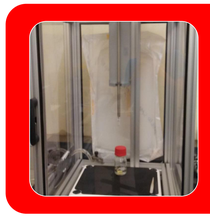


Figure 3: Fomblin Y has a very low vapor pressure and does not evaporate easily. FDP is also very soluble in Fomblin, due to them both having high amount of fluorination.

Procedure

Step 1

- Four test solutions were made to test the effects of adding Fomblin Y and FDP to PMMA (plexiglass) coatings.



Step 2

- Silicon wafers were dip coated into the solutions.

Step 3

- One set of samples was annealed at 100°C, another at 180°C, a final set was left unannealed.

Step 4

Contact angle measurements were taken to determine relative hydrophobicity of the different surfaces.

Contact Angle

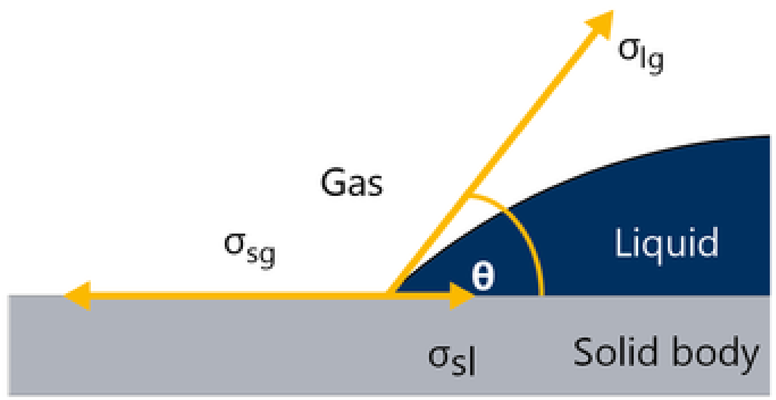


Figure 4: The higher the contact angle, the more repellant the surface is of the water. This is similar to water "beading up" on a freshly waxed car.

Results

Solution:	A	B	C	D
Contents:	80% AK225 10% PMMA 10% FDP	78% AK225 9% PMMA 9% FDP 4% Fomblin Y	67.5% AK225 27.5% PMMA 5% Fomblin Y	70% AK225 30% PMMA
Unannealed	74.9°	88.0°	70.0°	70.1°
Annealed at 100°C	93.9°	96.7°	79.0°	80.5°
Annealed at 180°C	92.9°	93.8°	75.0°	80.2°

Table 1: Contact angles of different samples in comparison to coating solution contents and annealing.

Conclusions and Future Work

- Adding Fomblin Y to dip coating solutions increased the contact angle of water on the samples, thus it increased the water repellence.
- Heating the samples in an oven for 24 hours at 100° C made the coatings more stable. The unannealed samples had their coatings "washed off" by the water during contact angle measurements.
- However, heating them for 24 hours at 180° C appears to have slightly degraded the coating, decreasing water repellence and contact angle.
- Future work will focus on determining the surface structure using SEM and other techniques, as well as testing other coating methods.

Program Sponsors

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