

Electrical Characterization of Repellix Coating

Jeff Chinn, Ph.D. Mark Wiltse Michael Craig 6/11/08

Electrical Properties Testing Results for IST Repellix Coating

- 1. What is the electrical resistance of Repellix versus uncoated boards?
- 2. Is the resistance only due to having a thin dielectric layer or does it repel liquid?
- 3. How does agitation affect the coating performance?
- 4. How does periodic air exposure affect the performance?

Testing was performed on comb structures in the IST lab A variety of liquids were tested :

- Tap water
- Gatorade
- Salt water
- Pond Water
- Pool Water
- Cola
- Coffee





Test Fixture and Conditions

- Copper comb structures
- 0.5mm gap
- PCB base board
- Comb immersed in liquid

Test Sequence A

- DVM set to Ohms
- Reading taken at time of immersion
- •Sample taken every minute

Test Sequence B

- DVM set to Amps
- Leads powered by variable power supply
- Reading taken at time of immersion
- •Sample taken every minute















Resistance as a Function of Immersion Time



- Repellix 25 to 85 times more resistive
- Repellix resistivity is due to repellancy

For this test, the combs sat in water for 30 minutes and the DVM measured the resistance, with a sample recorded every minute. The difference between an uncoated board (red) and Repellix (blue) was plotted on a log scale. Submersed Repellix was between 25X and 85X more resistive than a submersed uncoated board.

To test to see if the effect was due to repelling or just the additional layer of thin dielectric material, we coated one sample with a hydrophilic property. This is a similar thickness and structure to Repellix, but without the hydrophobicity. This board (green trace) performed very similar to an uncoated board. We conclude that the Repellix performance is due primarily to repelling the water.





Resistance as a Function of Immersion Time



Duration (Minutes)

Over 5 hours immersed in waterRepellix maintains high resistance under water

To measure long term immersion effects on Repellix resistance, we submerged the combs in water for over 5 hours and recorded the resistance. The first few minutes were off scale, so we plot them at 100 MegaOhms for convenience. After seven minutes the resistance was measurable at 40 MegaOhms, and we observe a slight erosion over five hours to 7.3 MegaOhms.

This sample was a denser recipe version of Repellix than the previous test, and the resistance is correspondingly higher.





Resistance During Water Droplet Test

Uncoated



Hydrophilic





- The uncoated board remained wet even after shaking
- As water accumulated on the uncoated board. it became less resistive
- Repellix board remained infinite resistance under all test conditions, and continuously dry
- The hydrophilic board retained wetness, and performed roughly similar to uncoated board electrically

For this test, a dropper was used to drop two droplets on the boards at a slight incline (approx 10 degrees). After 30 seconds, the board was shaken to assist water removal, and another data point taken after 60 seconds.

Open Line (unmeasurable Resistance) was recorded as 40,000 Kohms for the sake of plotting the data.





100

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Resistance as a Function of Dunk Cycles and Agitation



For this test, we dunked the combs in tap water, and agitated them back and forth for 10 seconds, and recorded a resistance reading. Then, we removed them for 20 seconds into the air and took a reading. This process was repeated for 10 samples (5 minutes).

Open Line (unmeasurable Resistance) was recorded as 40,000 Kohms for the sake of plotting the data.

- The Repellix combs retained super-hydrophobicity throughout and after the experiment
- Repellix board was 25 100 X more resistant than uncoated board while immersed
- Repellix board improved as cycles progressed unknown why
- Uncoated board was unable to shed all the water, and remained conductive even when removed for 20 seconds





Resistance as a Function of Immersion Time and Agitation



For this test, we dunked the combs in tap water, and agitated them back and forth for 5 minutes, and recorded a resistance reading every 30 seconds. The combs remained immersed throughout.

- Repellix board was 30 50 X more resistant than uncoated board
- Repellix board recovered to initial conditions after a short 2 minute period out of water
- Sloshing agitation did not seem to effect peformance





General Observations

- 1. What is the electrical resistance of Repellix versus uncoated boards?
 - 25 85 times more resistive
- 2. Is the resistance only due to having a thin dielectric layer or does it repel liquid?
 - Repelling the water is the major mechanism
- 3. How does sloshing agitation affect performance?
 - Not noticeable
- 4. How does intermittent exposure to air affect performance?
 - Seems to help film 'recover' or maintain superhydrophobicity



