



## Repellix™ Protection from Water Damage Catastrophes



- Protection from Accidental Drops
- Protection from Splashes or Rain
- Keeps Data Safe During Recovery
- Avoid Replacement Costs
- Operate Near Water with Confidence



**Lost Data is Just a  
Splash Away!**

### Losing Connectivity Can be a Disaster!

Because of their portability, consumer electronic products are continually at risk of damage by water. Cell phones dropped in pools or toilets, drinks spilled on laptop keyboards, water splashed on BlackBerry's are all common occurrences.

Water or liquid damage is among the top two reasons for early electronic failures and customer returns. Moreover, manufacturer's warranty terms strictly exclude water damage as a valid claim. There are even secret tell-tale stickers inside cell phones that turn red if moistened so that manufacturers can refuse these claims.

Water protection for these devices has been an after-market after-thought until recently. Clumsy clam shell skins, seals, and other types of water-proof packaging make the devices hard to use, degrade their designed ergonomics, and add significant cost. On the other hand, the "ruggedized" versions of these products are sold at high cost premiums.

Repellix from IST now offers a low-cost solution for protecting these devices from water or other liquid damage without degrading their appeal, nor ease of use.

### Repellix Protected Cellphone Lasts 30 Minutes Under Water - *Without Skins!*



That's right - 30 minutes without skins or gaskets.

Repellix directly coats the electronics inside - it is not a superficial skin or enclosure. It repels water so aggressively that it creates a displacement zone that fills with air as it pushes the water away. It is as if the electronics were still in the dry air, even though the device may be under water.

By coating the internal circuits with a super-thin ceramic layer, Repellix enables devices to retain their attractive ergonomics and usability. Flex connectors will even make positive connection through the coating, so no masking is required by the PCB and flex circuit assembler.

## What is Repellix?

- 100-2,000 X thinner than spray coatings
- Super-hydrophobic contact angles > 160°
- Electrical contact without masking
- Connectors or probes can penetrate the coating
- Excellent heat dissipation
- Ceramic structure is inert: electrically, chemically, and biologically
- Dry processing without volatile organic compounds (VOCs)

Droplets of a blue sports drink on uncoated silicon (left) form a large puddle. The Repellix-coated silicon (right) displays super-hydrophobic contact angles.

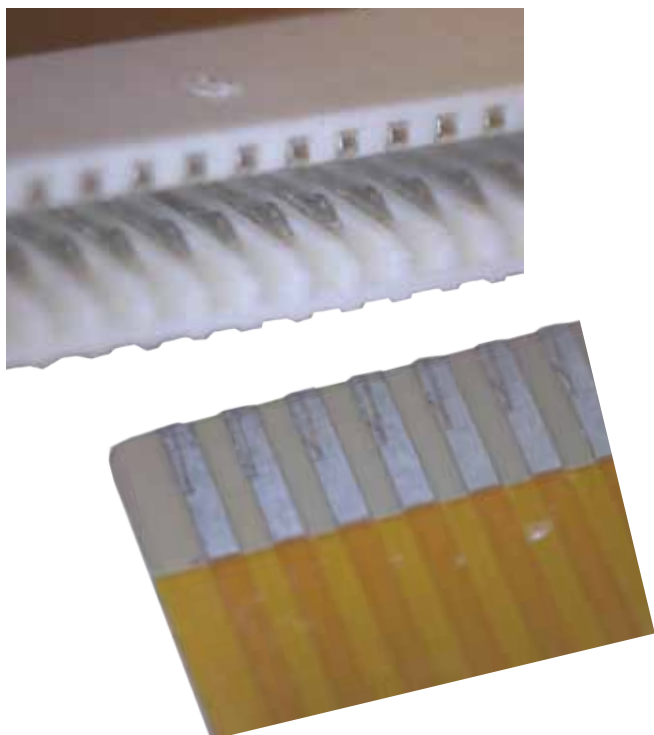


Un-Coated Silicon

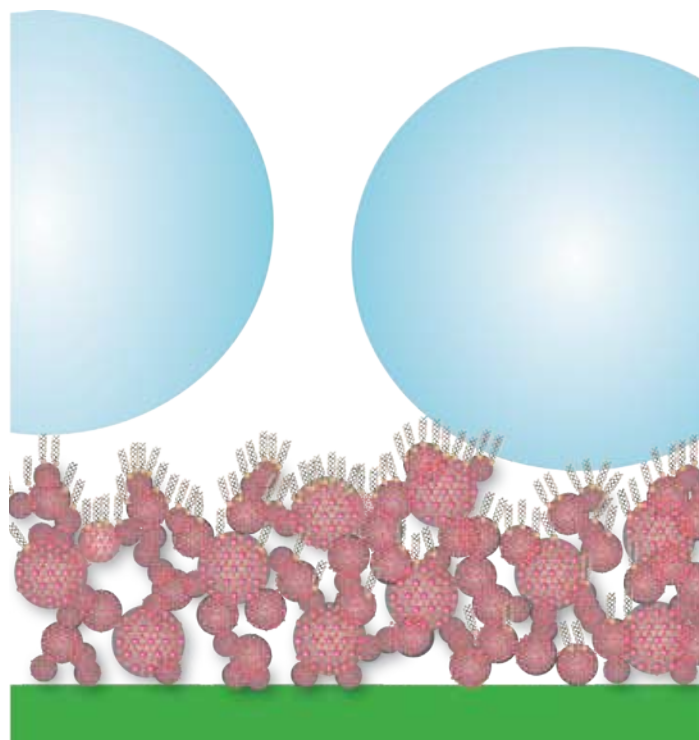
Repellix-Coated Silicon

### Flex Connector Friendly Coating

Flex Circuits are heavily used in the electronics industry. Since male and female connectors have to connect to their mates, designers cannot protect the connectors with conformal coatings that physically block electrical contact, so the connectors are left exposed to potential water damage. The hard metallic barbs can perforate Repellix and make excellent electrical connection, while remaining protected from water damage elsewhere.

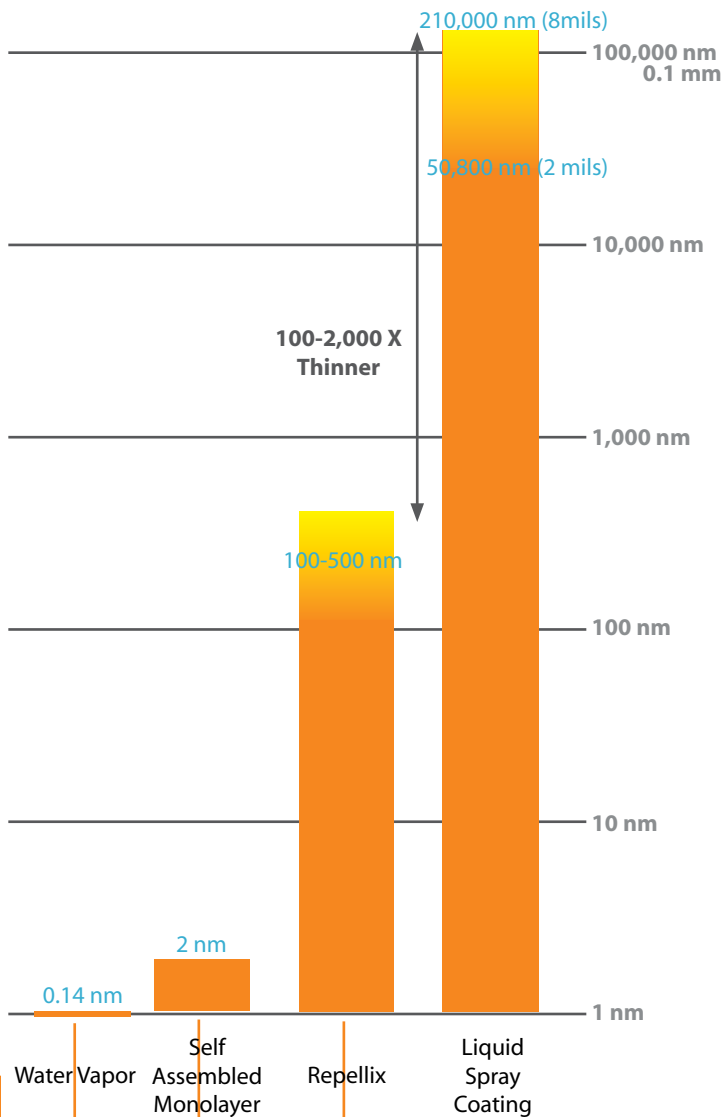


### Water Droplets Roll Off Repellix



Repellix's ceramic structure can be tuned to the desired density, depth, and hardness. The extremely low surface energy within the film itself repels water and other fluids. The film is so thin that it is practically invisible to the naked eye. Repellix's designed porosity allows for excellent heat transfer between PCB components and the environment. Additionally, Repellix allows for good and reliable electrical interface connections.

# Advantages of Thin, Super-Molecular Coatings



## Ultra-Thin Repellix Offers New Capability

Repellix is between 100nm and 500nm depending on customer requirements. The 100nm coating is only 4 millionth of an inch thick, or 1/10,000th of a millimeter. Traditional conformal spray coatings vary from 2 mils (Milspec) to 8 mils, or about 50,000nm to 210,000nm respectively.

## Heat Dissipation

Thick encapsulating coatings such as acrylics, urethanes, and silicones are poor conductors of heat, which is a serious detriment to advanced designs. Repellix is 100 to 2,000 times thinner, allowing heat to radiate away from the device

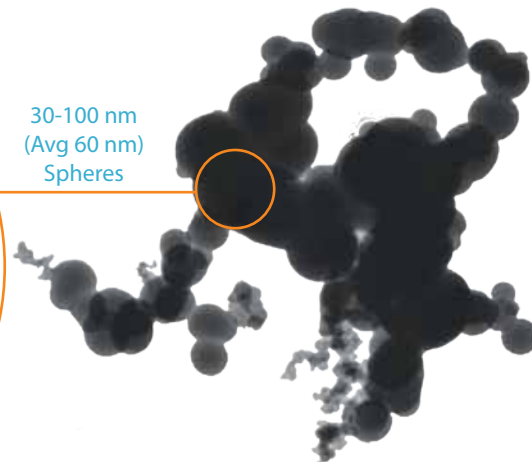
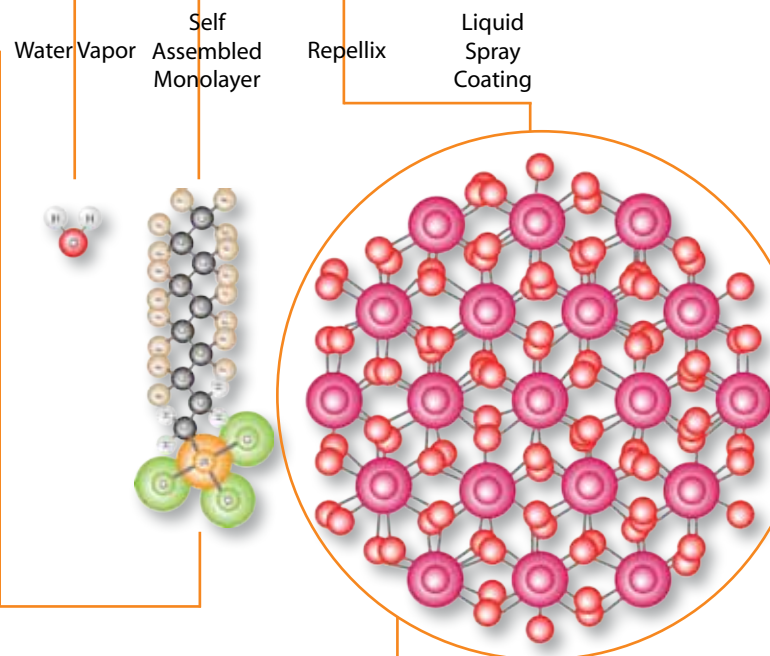
## Connectivity Without Masking

Flex connectors often use sharp metal bars to connect between the male and female components. Repellix is thin enough that the metal bars can puncture the coating and make solid electrical connection, while still retaining the protection from water.

## Improved Conformality

IST is capable of depositing a wide range of molecular coatings. Our self-assembled monolayers (SAMs) can be less than 2nm in thickness, and are extremely conformal and pervasive. The sub-atmospheric process allows the vapors to diffuse throughout the nooks and crannies of the smallest devices, even on the bottom side, unlike spray coatings that require line-of-site access.

The TEM image below shows an example of a Repellix formation of ceramic spheres varying in diameter from 30nm to 100nm. These spheres are connected together with a linking chemistry and the surface is then activated with a surface chemistry like that shown in the Self Assembled Monolayer example (to the left).



TEM image of Repellix Spheres

## Technical Specifications

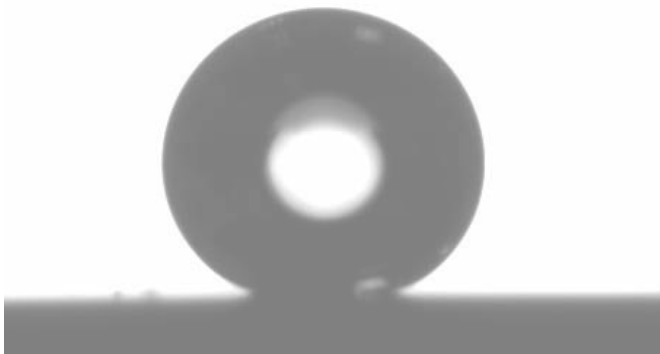
**Super-hydrophobic contact angles:** > 150°

**Contact angle uniformity:** +/- 5%

**Surface energy:** < 3  $\mu\text{Jm}^{-2}$

**Water Vapor Transmission Rate (WVTR):** <0.02gm/  
meter<sup>2</sup>-day (85% RH, Mocon on PEN 10nm film)

**Static submersion time:** > 6 months



**Estimated Density:** 2.4-2.5 g/cm<sup>3</sup>

**Stress:** <0.4 MPa @33°C

**Elastic (Young's) Modulus:** 165 GPa

**Hardness:** 12 GPa (Berkowitz Scale)

**Dielectric Strength:** 20 MV/cm

**Thickness:** 30-500 nm

**RMS (Roughness):** 60-120 nm

**Maximum Temperature:** 250°C for 1 hour

**Heat Dissipation:** Excellent

**Refractive Index:** 1.58

**Optical Transmission:** <2% absorption over spectra  
range 400-2100nm (20nm thick film)

## Test Results and Literature Available

