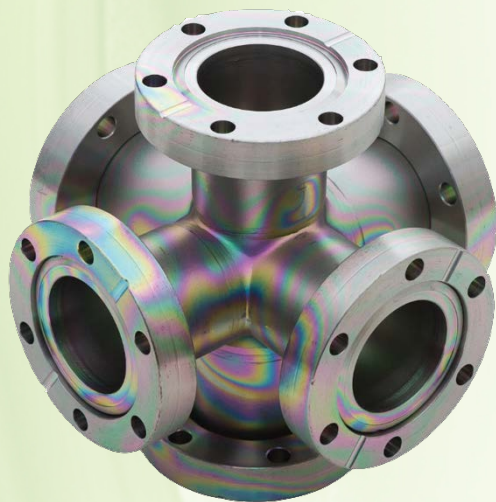


A Bulk, Low Energy Surface Treatment for 3-Dimensional Substrates via CVD Processing



Taking Control of Surfaces

- Silicon (Si) naturally prevents unwanted chemical reactions (adsorptive or corrosive) with substrate
- Functionalization further enhances silicon's advanced properties for demanding applications
- Chemical Vapor Deposition (CVD) process provides robust and repeatable outcomes

SilcoTek[®] Introduction

- Born in chromatography
- SilcoTek launched in 2009
- Focused exclusively on CVD coatings



Applications

Analytical Chemistry

Oil and Gas Exploration

Refinery/Petrochemical

Semiconductor Manufacturing

Bio/Pharma

Automotive

Aerospace

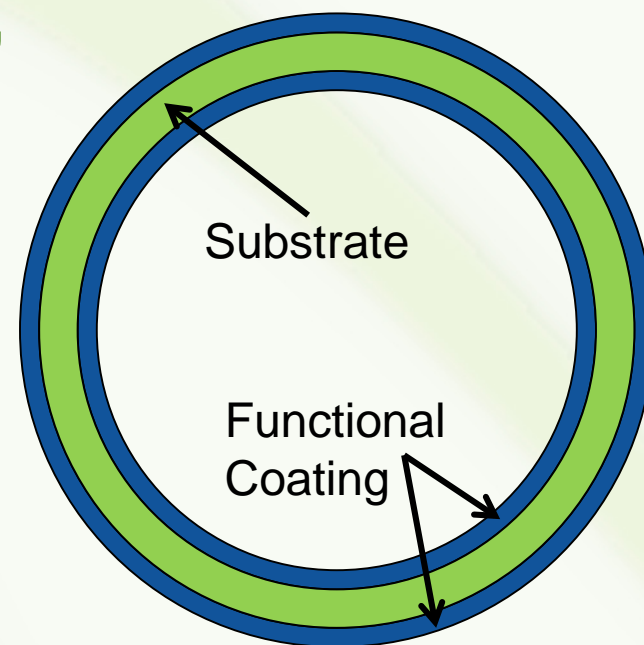
Offshore

Chemical Manufacturing

Power Generation

What we do

- Thermal chemical vapor deposition (CVD) “coatings”
- Amorphous silicon (a-Si)-based
- Functionalization for **advanced** properties

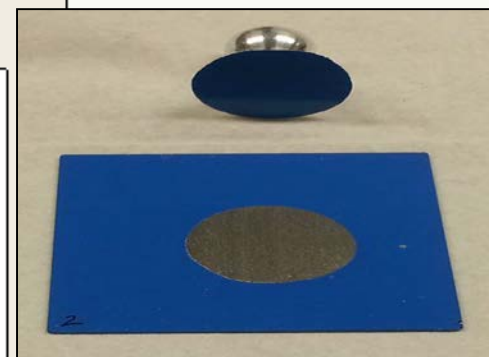
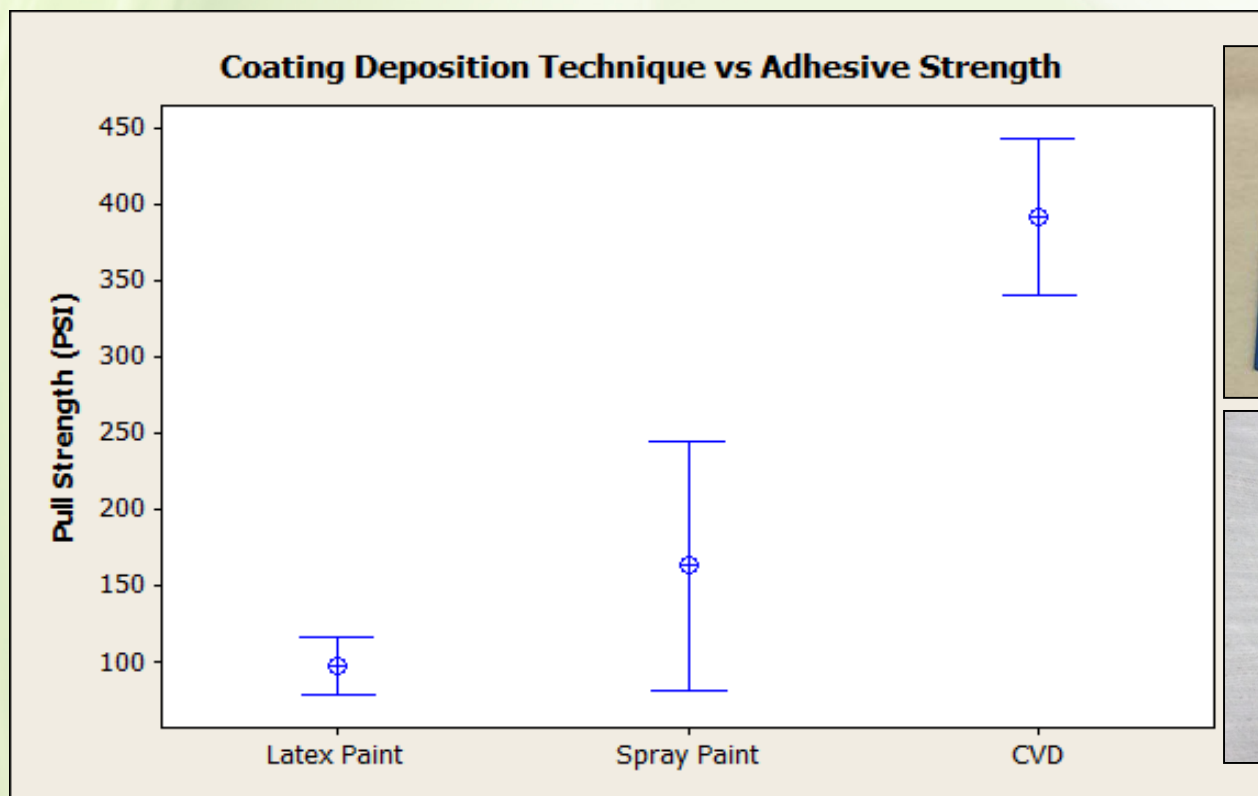




Advantages of CVD

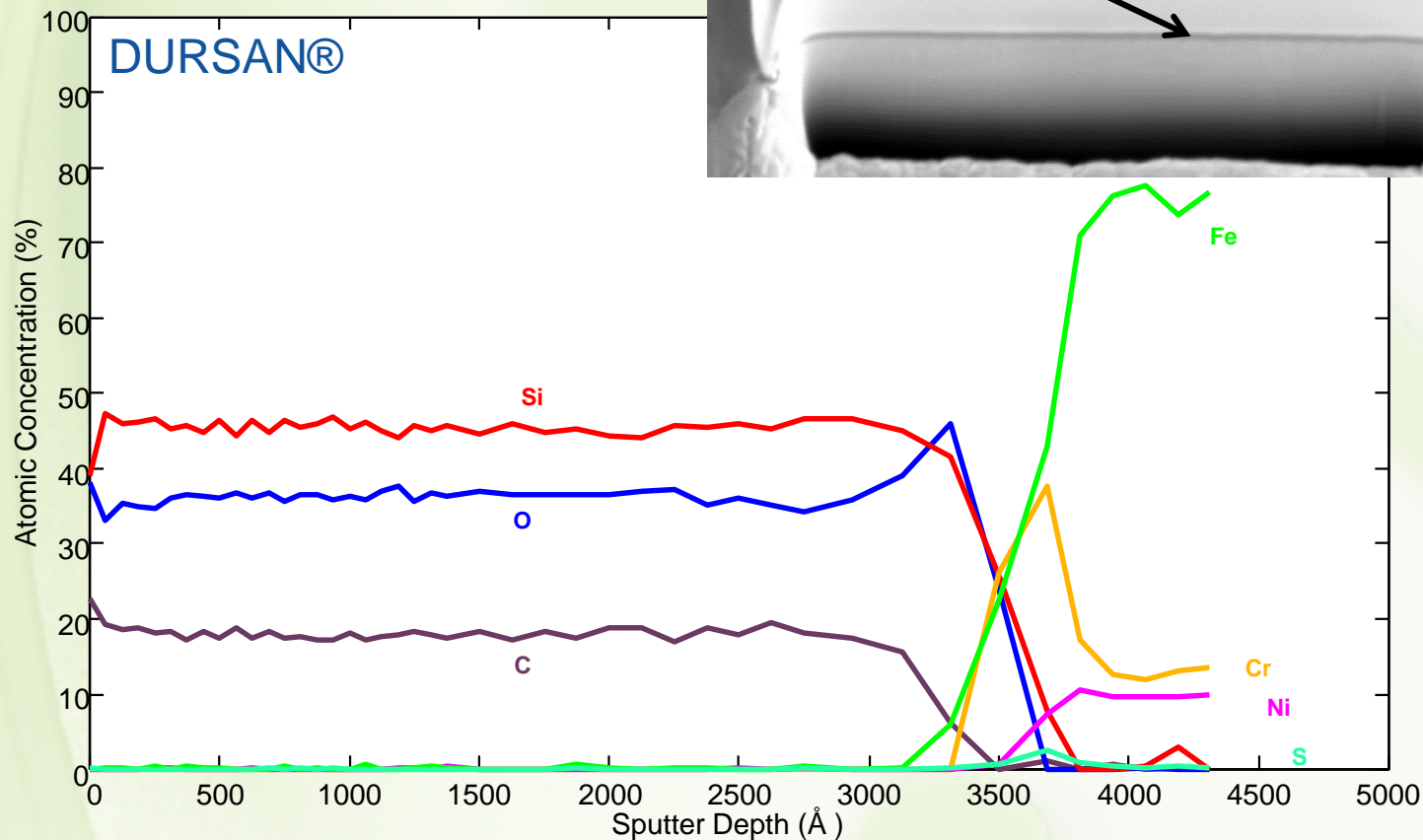
- Non-line-of-sight; uniformly treats 3D, high aspect ratio part geometries
- Molecular adhesion to base substrate
- Scalable, versatile, and highly reproducible

Coating Adhesion (Pull Strength)



- Adhesive Strength to Dursan® Fails Before Coating Adhesion to Substrate (>200-300 PSI)

Elemental Composition



* - Auger Electron Spectroscopy depth profile of Dursan® on 304 S.S.

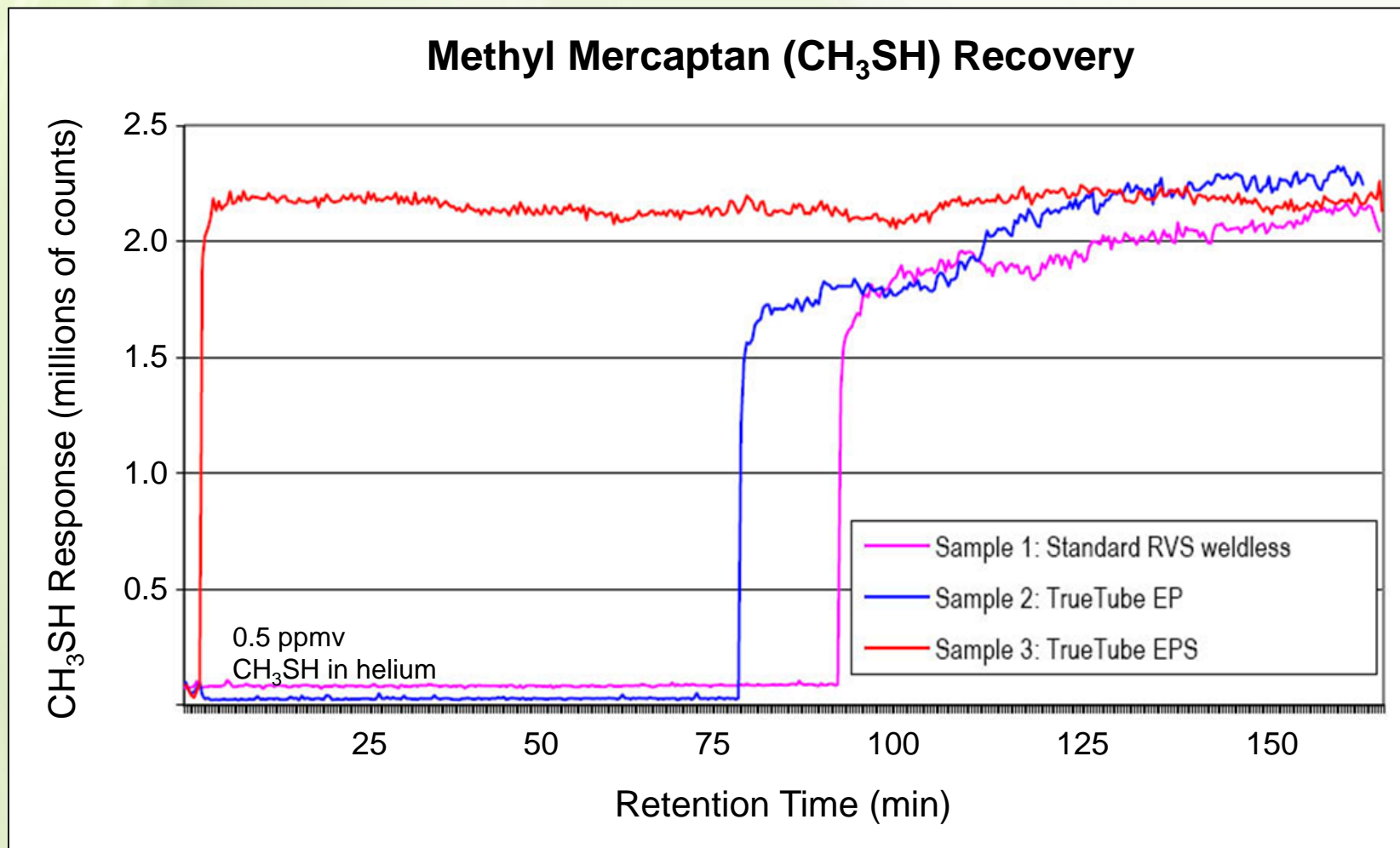
Coating Properties

1. Chemical inertness
 - Accurately analyze trace (as low as parts-per-trillion) H₂S, mercury, ammonia, etc.
2. Corrosion resistance
 - Longer life, less maintenance, lower costs
3. Low energy
 - Hydrophobicity, anti-stiction, anti-coking, etc.

Chemical Inertness

Preventing adsorption to allow
chemical detection at trace
($< \text{ppm}$) levels

Inert Barrier Stops Reactivity



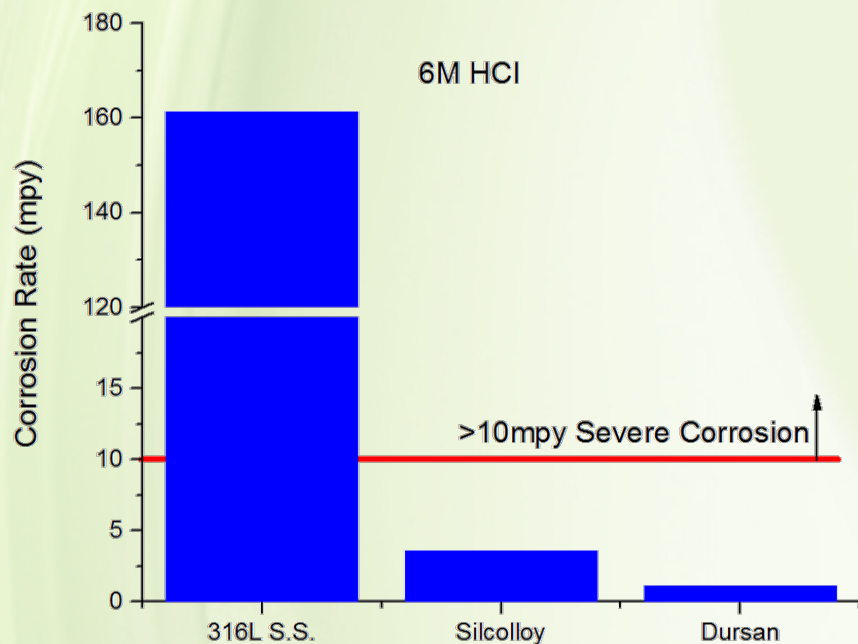
*Data courtesy of Shell Research Technology Centre, Amsterdam and O'Brien Corp.

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Corrosion Resistance

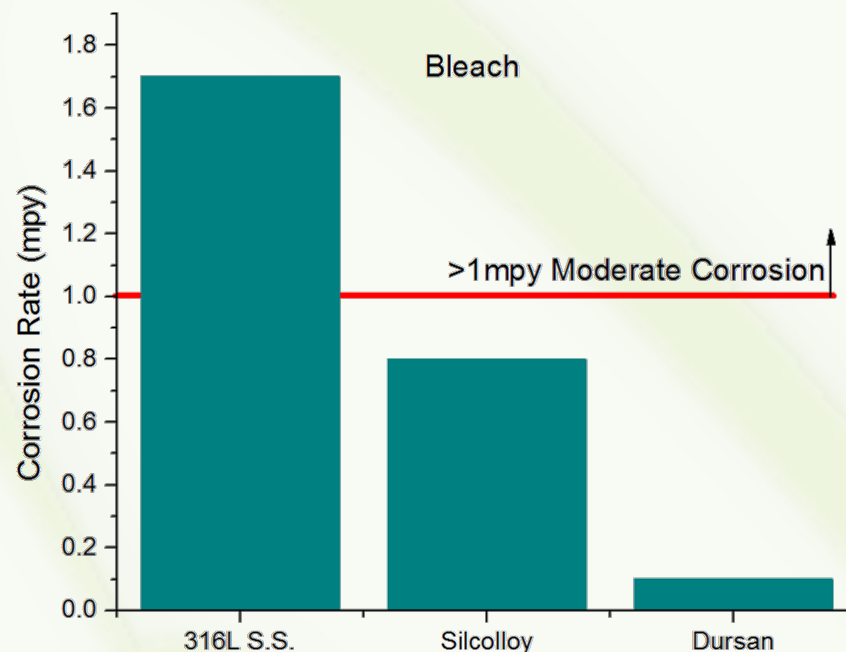
Increasing usable lifetime of ideal
materials of construction

Corrosion Resistance



- ASTM G31 Guidelines
- 6M HCl Acid Exposure
- 24 hrs at Room Temperature

- ASTM G31 Guidelines
- 15% NaClO Exposure
- 72 hrs at Room Temperature



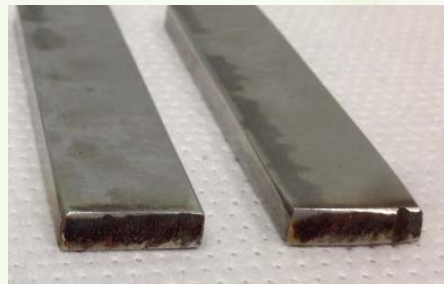
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Salt Spray

- 24 weeks of acidified salt spray per ASTM G85-A2. Total exposure time: 4032 hours.
- Uncoated coupons: moderate rust on all faces
- Duplex alloy 2205 showed rust on edges
- Dursan-coated coupons: no visual rust or weight loss



Bare 316L

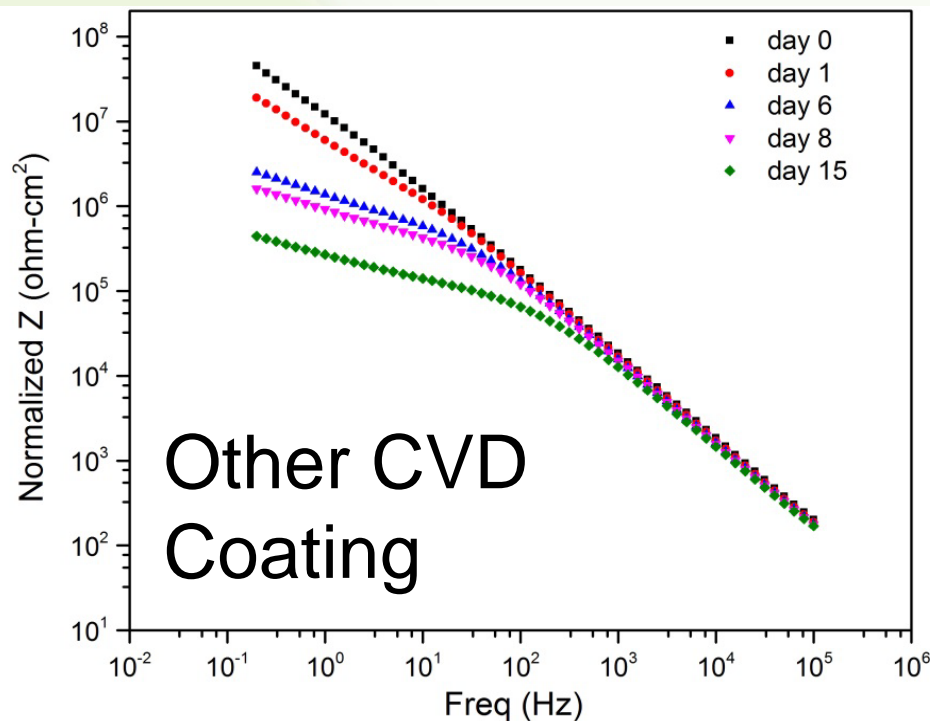
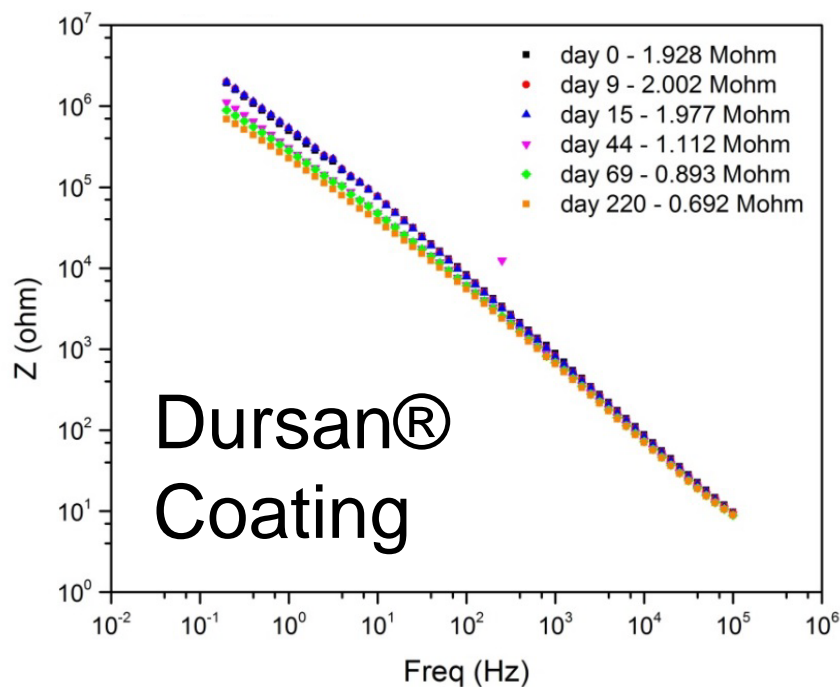


Duplex 2205



Dursan-coated

EIS – Salt Water (5% NaCl)



Dursan® shows dielectric stability over 220+ days in salt water, demonstrating sustained corrosion resistance

Low Energy

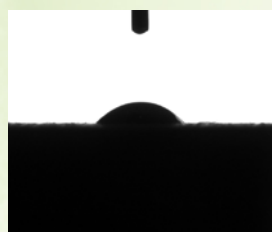
Increasing efficiency by
preventing adhesion of unwanted
media

Low Energy, High Potential

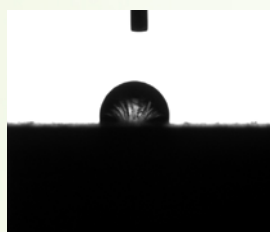
- Substantially reduce coking/fouling
 - Improve fuel efficiency in auto applications
- Prevent sticking
 - Biomaterials, chemicals, etc.
- Improve hydrophobicity
 - Needed in process monitoring, sampling, and other analytical applications



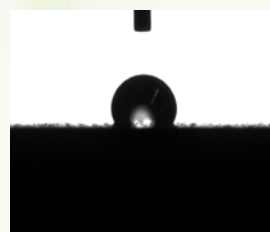
Hydrophobicity



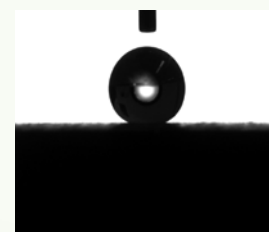
SN 1000
49°



SN 2000
101°



Dursan
121°

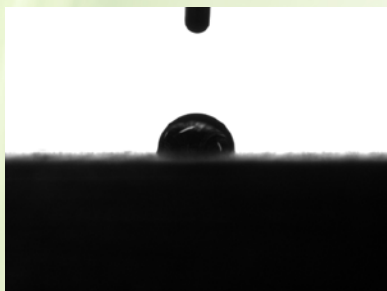


FluoroDursan
163°

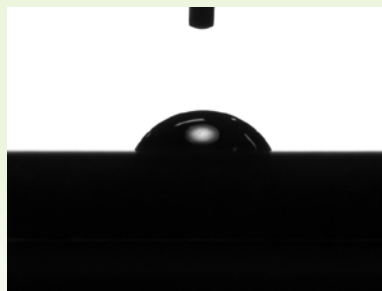
← **Rough Coupons**

Oleophobicity

SilcoTek-Coated



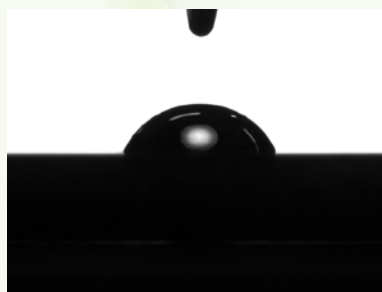
Hexadecane on rough
92.6°



Hexadecane on smooth
66.0°

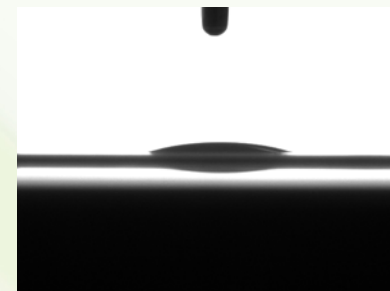


10W40 oil on rough
95.5°

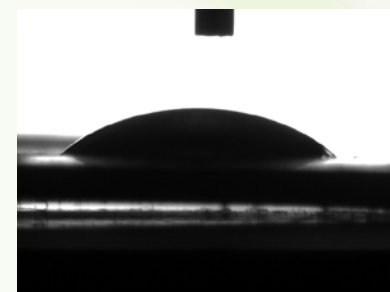


10W40 oil on smooth
70.2°

PTFE



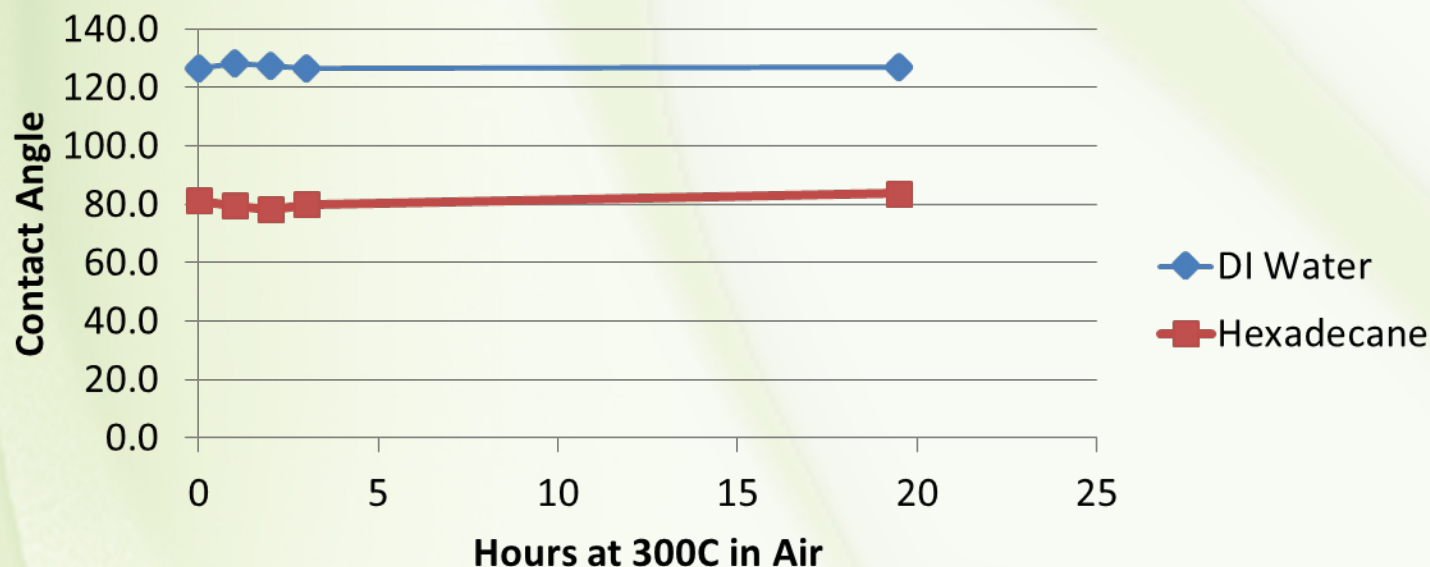
Hexadecane on PTFE
29.7°



10W40 oil on PTFE
48.5°

Stability of Low Energy Surface

FluoroDursan on 316 Contact Angle Change vs. Thermal Oxidation Exposure



Summary

- Functionalized silicon coatings provide ideal properties not attainable with base metals
- 3D CVD coating process is robust regardless of part complexity or tolerances
- Whether in the field or lab, SilcoTek coatings offer advanced surface performance



Questions?