"Working from Home"
Webinar Series:
Hydrophobic Surface Treatments
THANK YOU FOR JOINING US

Presenters

• Edward Hughes    CEO
• Mario Gattuso    Sr. Business Development Mgr.

Logistical

• Recorded
• Ask questions via GoToMeeting question tab
• Hope everyone is well and safe

• Pandemic – scope, speed, stakes

• Ability to adapt – “WFH”

• Essential company

• Be there for you when we come out of this
OUR GOAL

Aculon enables customers to make better products by being an innovative, responsive and fast developer and producer of best in class surface modification technologies.

Together we create winning products!
AGENDA

• Aculon Overview
• Technology Platforms
• Surface Modification Options
• Hydrophobic Applications
  – Electronics
  – Oil & Gas
  – Specialty
• Lab Services
• Q&A
ACULON OVERVIEW

Founded 2004

- **Expertise**
  Develop & produce surface solutions to modify a broad variety of surfaces (metals, glass, polymers).

- **Functionality**
  Hydrophobic, superhydrophobic, oleophobic, hydrophilic, anti-fingerprinting, adhesion promotion

- **Treatments**
  Thin, easy to apply (no vacuum chambers), often no cure, safe, non-toxic and offer green options.

- **Differentiation**
  Create proprietary innovative treatments & willingness to work with customer to solve problems.

- **Focus areas**
  Electronics, Oil & Gas, Specialty (Medical +other)

- **Business Model**
  Produce chemistry & treat parts

- **IP**
  Over 35 Patents granted. Worked with 1000’s applications, invested 100,000’s hours

- **Products:**
  > 100

- **People:**
  Smart (numerous Chemists with PhD’s & Masters Degrees, Electrical & Mechanical Engineers)

- **Global**
  Locations: San Diego (HQ, Lab & Manufacturing) Shanghai, Singapore, Dallas, Amsterdam,
  Distributors: > 12 in Asia

Aculon, Inc. @ 2020
Interaction with surfaces can create problems. Hydrophobic technologies can be used to address a wide variety of problems. Examples include:

1. Functional issue due to liquid behavior on surface
2. Cleaning a surface is time consuming & expensive, even impossible
3. Surface contamination (fingerprints) degrades a product's aesthetic behavior
4. Water droplets/contamination impede optical performance
5. Adhesive materials stick to surface
6. Surface is not lubricious enough
7. Wettability of a surface or powder is not ideal
8. Exposure to water results in electronics failure
9. Physical barrier to prevent liquid flow is not possible
Aculon’s proprietary “Self Assembled Monolayer of Phosphonates” (SAMP) can treat surfaces to impart repellency.

The SAMP monolayer is comprised of a phosphonic acid and a repellent, carbon-based molecule:

1. Phosphonic acid reacts with the surface and creates a covalent bond at the substrate: phosphonic acid interface  
2. The carbon group connected to the phosphonic acid is the functional mono layer  
3. The monolayer is less than 5 nanometers thick
VERSATILE TECHNOLOGY

TAILOR THE “R” GROUP STRATEGY

“Hook”
• Strong Chemical Bonds – Resistant to Abrasion
• Chemically Resistant – Stable as the Underlying Substrate
• Thermally-Stable – up to 175-250°C in ambient air.

“Tail”
• Surface Functionality – Lubricity, Cleanability, Surface Energy
• Interfacial Functionality – Reactivity, Adhesion of Polymers

Example “R” Groups

\[ R = \text{-OH} \quad R = \text{CH}_3 \]
\[ R = \text{-COOH} \quad R = \text{CF}_3 \]
\[ R = \text{C}_2\text{H}_5 \]

AcuIon, Inc. @ 2020
MANY SURFACE MODIFICATION PLATFORMS

- Hydro/Oleophilic
- Surface Polymer Growth
- Transition Metal Complexes
- Polymeric Organometallics
- SAMP & Organometallic
EXPERTISE AND PLATFORMS

- Hydrophobic Treatments
- Adhesion Promotion
- Hydrophilic Treatments
- Water barrier protection
- Anti-Fingerprint Treatments
- Oleophobic Treatments
- Particle Treatments
- Surface Modification
HYDROPHOBIC SURFACE TREATMENTS

Variety of surface modification technologies capable of functionalizing numerous substrate types to be hydrophobic:

• **Repel Water**
  • Reduction of surface energy repels water and most liquids
  • Hydrophobic $>$100°, Superhydrophobic $>$ 120°

• **Optically Clear**
  • Ultra thin and optically clear coatings leave surface appearance and feel intact

• **Flexible**
  • Coat nearly any substrate type: metal, glass, ceramics, polymers, etc.
The substrate in question needing hydrophobic modification will drive the options available:

**Metals & Oxide Containing Surfaces** (Ceramics/Semiconductors/Glass)
- SAMPs
- TMCs
- Surface Growth Polymers
- Polymeric Organometallics

**Polymeric (non-oxide) Surfaces**
- TMCs
- Polymeric Organometallics

*Certain polymeric substrates when functionalized to behave as an oxide containing surface*
HYDROPHOBIC DURABILITY

Treatments are chemically robust with options that can withstand most any environment or exposure condition:

- **Thermal Stability**
  - Thermally stable in ambient air
  - 200-300°C depending on technology type

- **Abrasion Resistance (Treatment Dependent)**
  - Strong covalent bonding
  - “As strong as the underlying substrate”
  - If your substrate will survive the environment undamaged, our coatings will too.

- **Chemical Stability**
  - Resistant to nearly any chemical depending on substrate and technology type
  - pH 10+ can be problematic

- **UV**
  - Poor resistance & bad fit
Hydrophobic treatments are robust and scalable for high volume commercial applications. Treatments are all applied via wet chemical processes, meaning no deposition equipment, chambers, or batch processing, ever! Application process depends on the application but can include:

- Dip Applied
- Spray Applied
- Wipe Applied
- Dispense/Jet

Parameters:
- Concentrations
- Solvent
- Coverage
- Temperature
ACULON FOCUSES

1. Electronics

2. Oil & Gas

3. Specialty
Applications include:

- **NanoClear®**  #1 Global Stencil Coating
- **NanoProof®**  Award Winning PCB protection, Moisture Barrier, Silver Migration prevention, underfill dam, connector coating
- **Anti-Fingerprinting**  Laptop / tablets, Appliances, Packaging
- **Epoxy Control**  Semiconductor wafer packages, leadframe mold flash
- **Acustamp**  Semiconductor test pins & fixtures
Extremely thin flux-repellent film applied to stencil underside & aperture walls

1. Improve Quality
   Higher yields
   Better transfer effectiveness

2. Boost Productivity
   Less underwiping
   Less downtime for paper changes

3. Reduce Costs
   Less rework
   Lower paper and solvent consumption

Nanoclear is a SAMP Coating
(Self-Assembling Monolayer Phosphonate)
Winner Circuits Assembly
New Product Introduction Award
NANOCLEAR SUMMARY

#1 Globally

• Not just for fine pitch stencils
• Easy to calculate benefits:
  - Improved Quality
  - Boost productivity
  - Reduced Costs
• Coats the aperture walls
• Techniques to enhance durability – Soft wipes & clean better!
• Continue to innovate to meet customer demand
• Available locally on a global basis

Nanoclear enables higher quality, more cost-effective stencil print process
ANTI-FINGERPRINT (AFP) TECHNOLOGIES

Aculon offers several easy clean and Anti-Fingerprint (AFP) treatments for electronics and other applications.
AFP COATINGS – EASY CLEAN

Extremely thin optically clear easy clean treatments are applied to the surface which:

• **Increase functionality**
  • Significantly improves the ease of cleaning fingerprint contaminated surfaces

• **Allow for cleaning with no solvents**
  • Remove fingerprints with dry cloth wipe

• **Durable**
  • Robust coatings offer ongoing AFP performance after normal handling
In real life, electronic devices are often damaged

- Device dropped in pool or even toilet
- Unit exposed to outdoor environment – rain, humidity
- Household appliances exposed water during operations
- Equipment (industrial and medical) exposed to wet working environment
NANOPROOF® SERIES

Aculon NanoProof® Series provides water protection from humidity to full water immersion

- Utilize proprietary technology
- Application equipment affordable and readily available
- Range of treatments available to meet performance, thickness, application and economic needs. From IPX3 to IPX8

Winner 2016 and 2019 Circuits Assembly New Product Introduction Award
### NANOPROOF BENEFITS

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<th>IPX</th>
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<th>Non-Toxic</th>
<th>Push Through</th>
<th>Flexible</th>
<th>Green/VOC Exempt</th>
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BENEFITS

1. Reduce Product returns due to water damage
2. Improve yields as rework is possible after coating
3. No or minimal masking required
4. Coatings are safe, non-toxic and can be used in factory environment
5. Affordable
The coating process depends on the treatment selected but could include:

- Spray
- Jet or Dispense
- Dip
NanoProof material can be inspected by automated or handheld UV inspection system
APPLICATIONS

Enhanced Oil Recovery:
Treat rock formation down well to reduce water blockages and enhance oil flow for new well completions and remediations.

Anti Fouling:
• Storage tanks and stainless pipes to prevent paraffin and asphaltene build up due to contact with crude oil
• Oil spill containment booms & equipment
• Treat sapphire to prevent oil wetting on surface impacting optics
Applications include

- Medical Devices
- Sapphire Optics
- Cutting tools
- Wheel Weight adhesion
- Particles

- Watches
- Guitar Strings
- Movie Screens
- Optical / Sunglasses
Applications:

- **Needles & Syringes**
  - Functionalize needles and syringes to have more consistent behavior

- **Electronic devices**
  - Improve easy clean and anti smudge characteristics
  - Eliminate failure due to water exposure

- **Stents & other similar devices**
  - Alter device surface behavior

- **Mesh/Screens**
  - Alter surface behavior by imparting hydrophobic functionality
Functionalizing sapphire optics to be hydrophobic can significantly improve performance:

- **Increase Service Life**
  - Reduce cleaning frequency of sapphire viewports in extremely difficult to access environments (downwell, industrial, manufacturing)

- **Repels all liquids**
  - Prevent fouling of both water & oil based fouling materials

- **Durable**
  - Extremely robust coatings survive the most aggressive environments
PARTICLE TREATMENTS

Ability to change functionality of broad variety of particles & powders for specific behavior via hydrophobic functionalization:

- **Surface Energy**
  - Options available for increasing or reducing surface energies of particles for desired performance

- **Easy Application**
  - Liquid based treatment options make bulk treatment of particles easy & scalable

- **Applications**
  - Functionalized particles and powders add value in performance in wide variety of applications
Strong combination of hard and soft IP:

- Granted over 35 Patents
- Developed many trade secrets
- Treated and tested thousands of applications
- UCSD Partnership gives access to millions of dollars of equipment
- Spent hundreds of thousands of hours solving surface problems
- Invested millions of dollars in building capabilities & expertise
Aculon is committed to offering a range of environmentally friendly products and follow good sustainable business practices. We help our customers support their sustainability goals and help protect the environment.

**VOC-Exempt Options**

**PFOA-Free Products**

**Eco-Packaging & Waste Reduction**
- Nearly all Aculon packaging (shippers, pails, bottles) is reusable or recyclable
- Green alternatives are utilized wherever possible
- From paper to pens, reusable or recyclable office supplies are used throughout our business operations

**Reduced Transportation-Related Emissions**
- Reduced material used → reduced transportation of material & wastes
- Localization with suppliers & distributors in Europe & Asia
- Utilize carbon-neutral shipping options when using UPS

**Sustainable Energy & Increased Efficiency**
- Retrofitted LED Lighting Throughout our HQ (>800 LEDs) & Utilize Extensive Natural Light
- Switched to Energy Efficient Equipment
CONCLUSION

- Platform technology company that make customers products better!
- Surface solution experts
- Strong history of working with customers to solve problems
- Broad portfolio of products, including more sustainable options
- Strong IP, testing capabilities and in-house expertise
PERFORMANCE. SURFACE. SOLUTIONS

THANK YOU