Aculon Webinar Series:

Optical Applications

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THANK YOU FOR JOINING US

Presenters

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

Logistical

- Recorded
- Ask questions via GoToMeeting question tab

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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!

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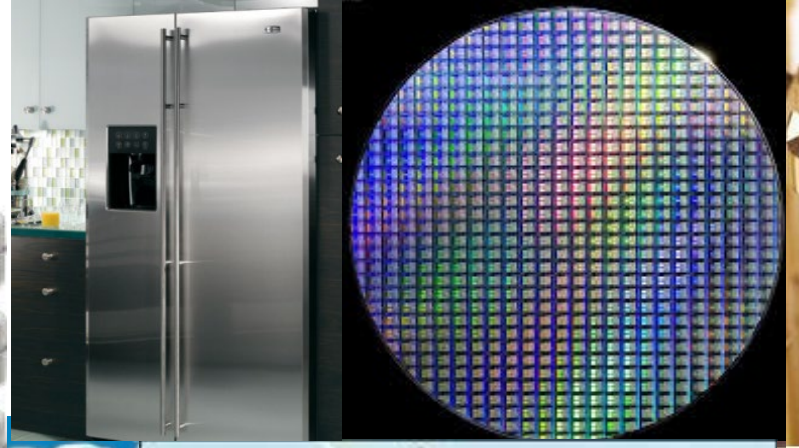
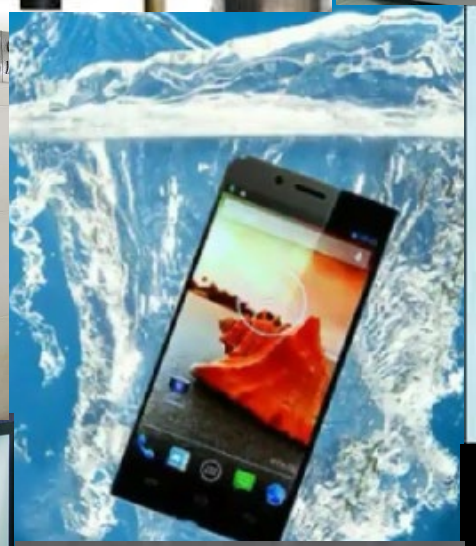
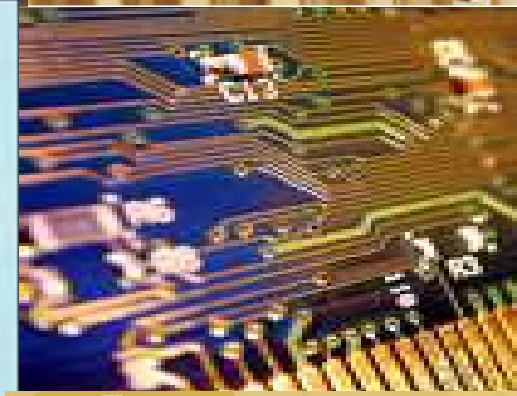
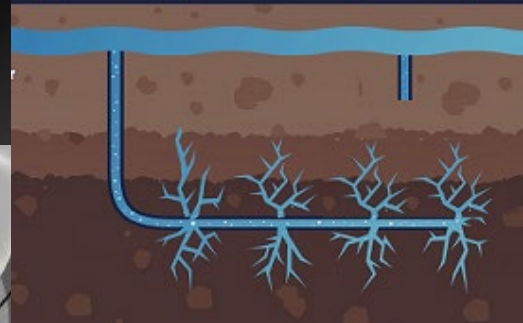
AGENDA

- Aculon Overview
- Technology Platforms
- Surface Modification Options
- Applications
- Lab Services
- Q&A





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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

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WHY SURFACES MATTER?

Undesirable surface behavior can create problems in optical applications. Surface coating technologies can be used to address a wide variety of these problems. Examples include:

- Fogging & moisture build up negatively impact optical performance.
- Cleaning optical surface is time consuming, expensive, or impossible.
- Fingerprints negatively impact performance of optics.
- Functional issue due to liquid behavior on surface
- Contamination and fouling materials negatively impact optical behavior
- Improved adhesive/bonding characteristics are desired on optical surfaces.
- Surface is not lubricous enough
- Wettability of an optical surface is not ideal

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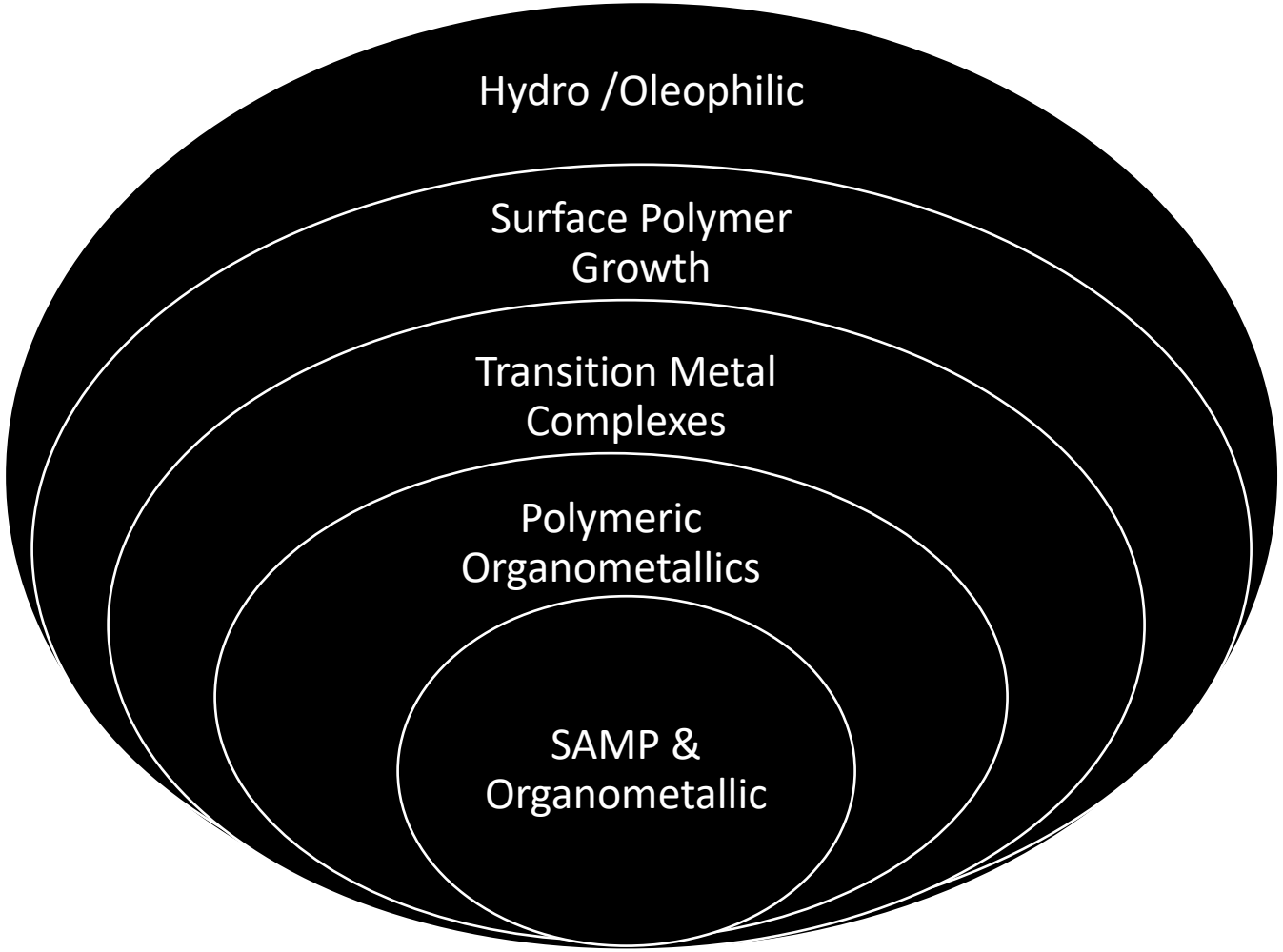
MANY SURFACE MODIFICATION PLATFORMS



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SUBSTRATE & CHEMISTRY MATCHING

The substrate in question needing modification will drive the options available:

Oxide Containing Surfaces
(Ceramics/Semiconductors/Glass)

- Repellency
  - SAMPs
  - TMCs
  - Surface Growth Polymers
  - Polymeric Organometallics
- Adhesion
  - SAMPs
- Hydrophilic
  - Surface Growth Polymers
  - Hardcoats

Polymeric (non-oxide) Surfaces

- Repellency
  - TMCs
  - Polymeric Organometallics
- Adhesion
  - Not Available
- Hydrophilic
  - Hardcoats

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

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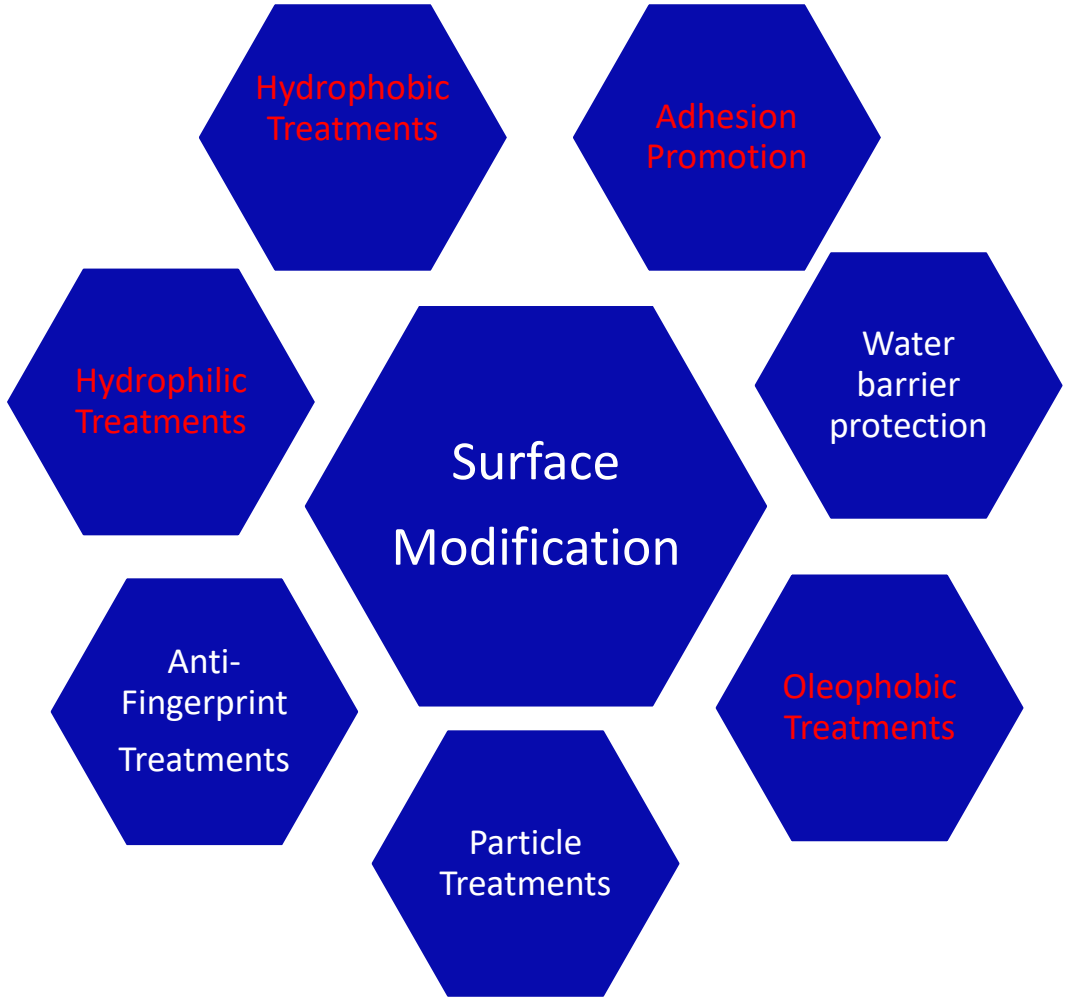
EXPERTISE AND PLATFORMS



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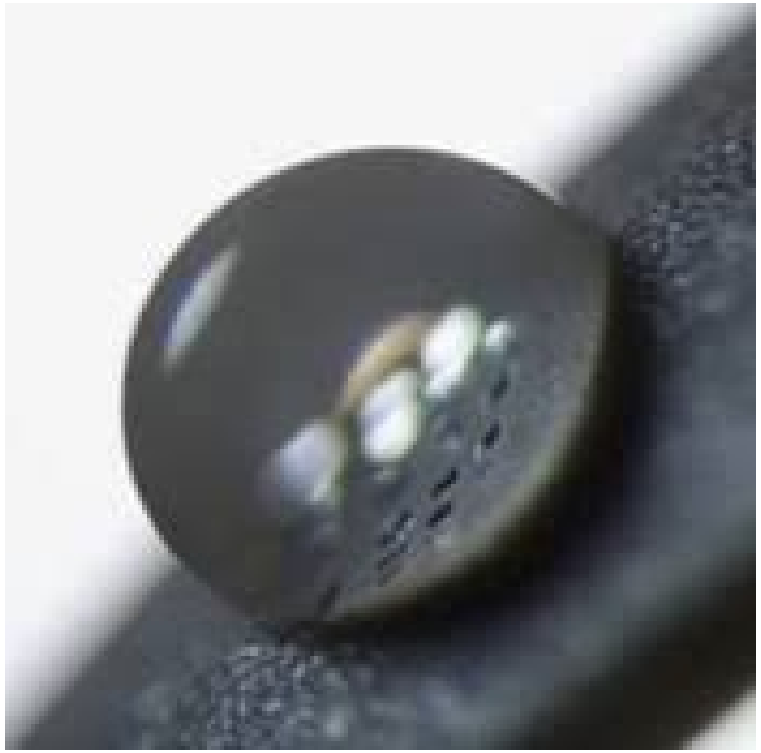
REPELLENCY TREATMENTS

Variety of surface coatings technologies capable of functionalizing optical substrates to be repellent (hydrophobic & oleophobic):

- **Repel Water, Oil, Solvents**
  - Reduction of surface energy repels water, oil, solvents and most liquids
  - Hydrophobic >100°
  - Oleophobic >60°
- **Optically Clear**
  - Ultra thin and optically clear coatings leave surface appearance and feel intact
- **Flexible**
  - Coat nearly any optical substrate type: glass, ceramics, polymers, etc.



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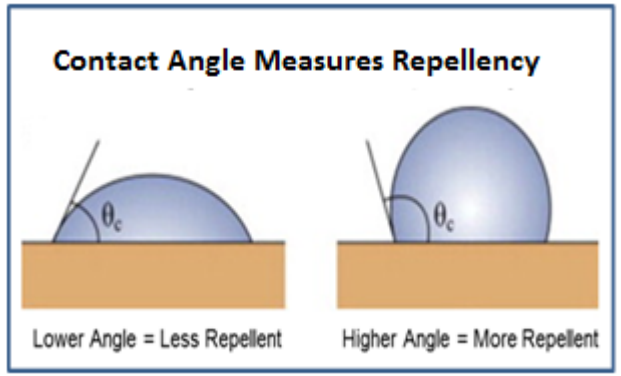
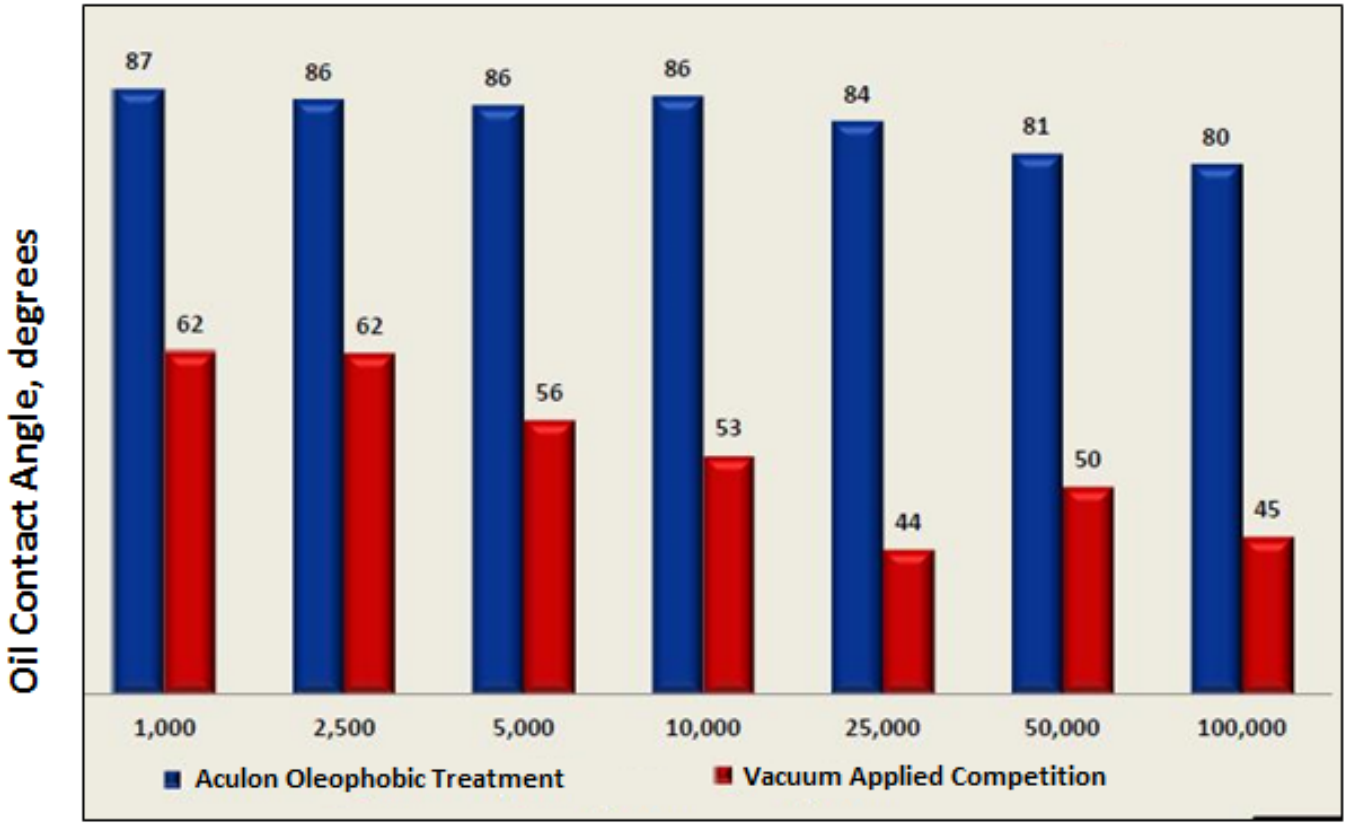
REPELLENCY PERFORMANCE

CONTACT ANGLE



Oleophobic Treatment - Durability testing done utilizing a dry wipe on a linear taber abrader as a proxy for real world abrasion treated parts will experience during usage.

ABRASION RESISTANCE



Conclusion: "Aculon's repellent treatment results in oil contact angles that are high and consistent, dropping less than 10% over 100,000 abrasion cycles"

HYDROPHILIC TREATMENTS

Functionalize variety of surfaces to increase surface energy and improve water wetting (hydrophilic) characteristics:

- **WCA <10°**
  - Water wets and spreads uniformly across functionalized surface
- **Optically Clear**
  - Ultra thin treatments are optically clear and do not impact surface appearance or feel
- **Anti-Fog**
  - Water wets evenly providing optimal performance in humid environments
- **Durable**
  - Depends on the application

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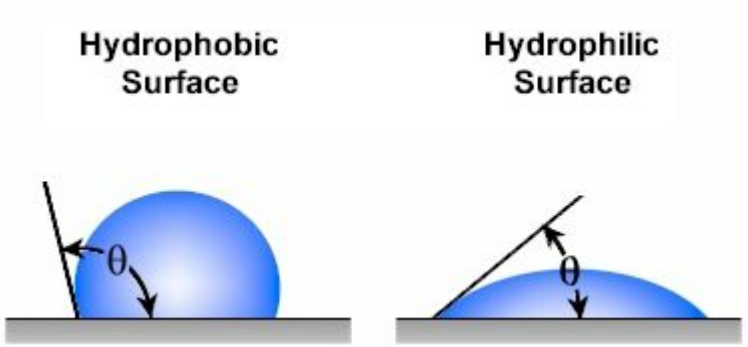
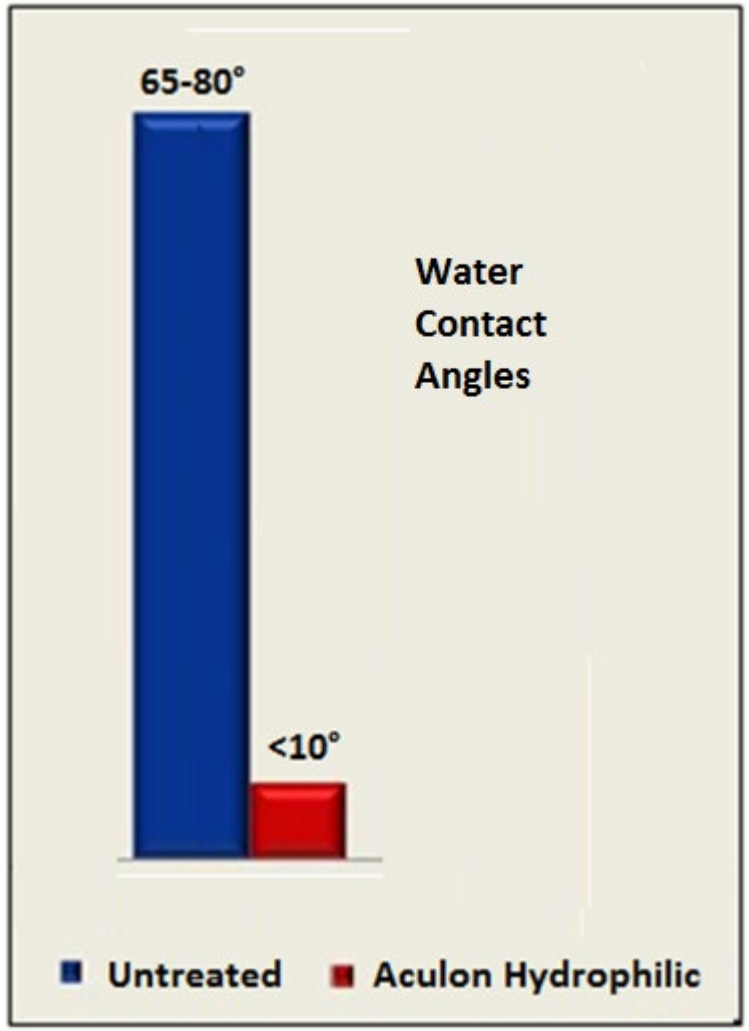
HYDROPHILIC PERFORMANCE

CONTACT ANGLE



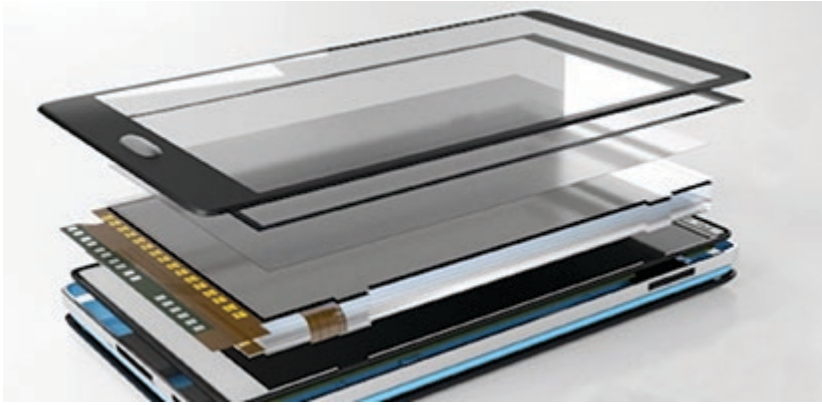
Conclusion: "Aculon's hydrophilic treatment results in water contact angles that are low and consistent"



ADHESION PROMOTION

Improve adhesive and bonding characteristics of oxide containing substrates:

- **Functionalize Surfaces Directly**
  - By directly functionalizing the substrate surface, delamination and adhesive failure are reduced
- **Reduce Thickness**
  - Traditional roughening for adhesion can be eliminated
- **Flexible**
  - Compatible with numerous oxide containing substrates & variety of functional adhesives



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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

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AWARD WINNING TECHNOLOGY

2020 Global SMT Technology Award Winner!

- Conformal Coating Materials Category
- Aculon Anti Fingerprint Technologies

TECHNOLOGY APPLICATION

Aculon's surface treatments for optics 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
- Selective Deposition

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IN HOUSE CAPABILITY

Aculon has a wide variety of manual and automated/programmable application equipment at their disposal for process optimization.

Automated Production Spray Equipment

Precision Nordson Asymtek Spray/Dispense/Jet

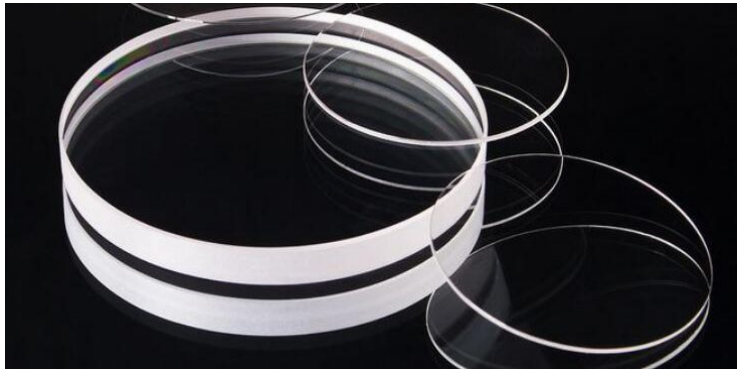
Automated SCS Dipping

ACULON OPTICS FOCUS AREAS INCLUDE

Anti-Fog

Medical Devices

Industrial (Oil) Sensors



Sapphire

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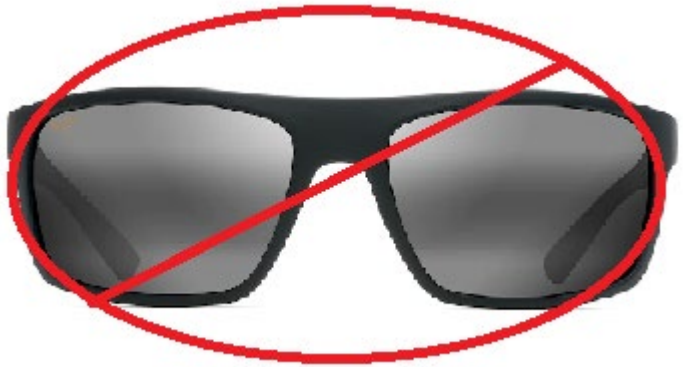
NOT OF INTEREST TO ACULON

With years of experience working on 100's of optical applications we have learned some applications are an excellent fit for Aculon's line of technology while others are not. Below are examples of applications which for a variety of reasons are a poor fit:



Consumer Eyewear

Automotive Windshields

Display Screens

Exterior Glass

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ANTI-FOG

For optical applications requiring optical clarity in wet or humid environments Aculon's hydrophilic surface treatments are a perfect fit!

- **Hydrophobicity is NOT the answer**
  - Common misconception that a hydrophobic treatment is needed to repel water from glass or camera domes/lenses
    - Hydrophobic treatments cause beading, which result in optical aberrations
  - Hydrophilic is the better fit!
    - Hydrophilic treatment results in a water wetting surface minimizing optical impacts
- **Aculon can apply a robust hydrophilic solution to a variety of optical substrates**

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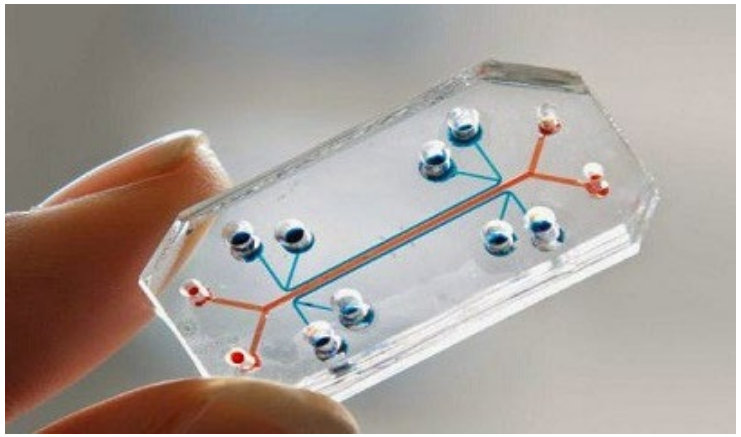
MEDICAL DEVICES & DIAGNOSTICS

Functionalizing optical components used in medical devices and medical diagnostic equipment can have dramatic impacts on performance:

- **Medical Imaging** – Functionalize optics for repellent or hydrophilic behavior depending on desired performance impacts.
- **Medical Diagnostics & NanoSensors** – Functionalize optical components to optimize fluid & droplet behavior for improved analysis.
  - Hydrophilic treatments increase surface wettability
  - Repellent treatments increase contact angles and lead to consistently behaving droplets.



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SAPPHIRE & PRECISION OPTICS

Synthetic sapphire and precision optical parts can be functionalized in a variety of methods to improve performance.

- **Repellency (Oleophobicity & Hydrophobicity)**
  - Reduce or eliminate cleaning frequency of parts in extremely difficult to access environments
- **Hydrophilic Functionality**
  - Improve optical clarity in humid/wet environments
- **Adhesion Promotion**
  - Functionalize sapphire for improved adhesion to a variety of adhesives & coatings

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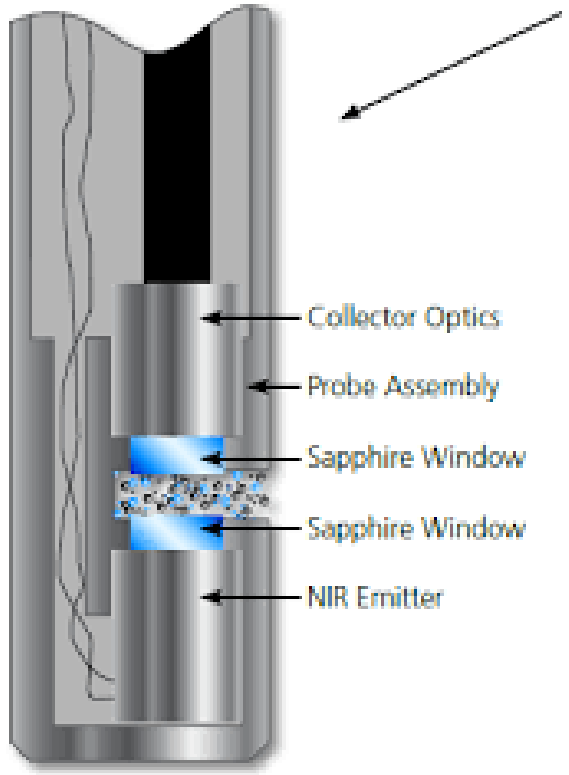
INDUSTRIAL & OIL SENSORS

Functionalizing optical sensors used in the industrial & oil industries to be oleophobic can have dramatic impacts on performance in the field:

- **Increase Service Life**
  - Reduce cleaning frequency of sapphire & glass 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



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LAB SERVICES

Understand Customer Requirements → Aculon Lab Services → Analyze & Characterize → Customer Testing & Feedback → Optimize → Selection & Recommendation → Customer Plant Trial

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INTELLECTUAL PROPERTY & EXPERTISE

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

SUSTAINABILITY

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

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PERFORMANCE. SURFACE. SOLUTIONS

THANK YOU

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