SURFACING SCIENCE™

www.universalphotonics.com EMAIL: info@universalphotonics.com UNIVERSAL PHOTONICS ADVANCED SURFACING PRODUCTS & TECHNOLOGY VOLUME 6

GLOBAL HEADQUARTERS
UNIVERSAL PHOTONICS INCORPORATED
85 Jetson Lane
Central Islip, NY 11722 USA
T: 516.935.4000
F: 516.935.4039

DISTRIBUTION FACILITIES
New York • California • Hong Kong

MANUFACTURING FACILITIES
85 Jetson Lane
Central Islip, NY 11722 USA
T: 516.935.4000

10 Ward Street
Vernon, New York 13476 USA
T: 315.829.3600

FAR EAST OFFICES

JAPAN: TOKYO
T: +81 3 6205 4121

CHINA: NANJING
T: +86 25 5287 6893

CHINA: SHENZHEN
T: +86 755 2584 9294

HONG KONG
T: +852 9456 8628

KOREA
T: +82 31 217 5873

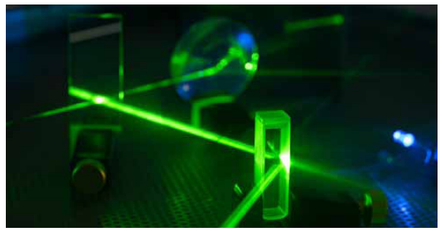
TAIWAN
T: +886 6505 2996

SUPER-POLISH

Delivering Optics to Enable Cutting-Edge Applications

In the world of optical fabrication, Super-Polishing has the full attention of the precision optics industry. Engineered to overcome some of the disadvantages of conventional polishing, Super-Polish technology produces extremely smooth surfaces with roughness less than 1Å, over a wide power spectral density (PSD) band, which reduces scattered light and delivers higher efficiency. These resulting characteristics are critical for optical components used in X-ray technology, high precision lasers, photolithography, performance telescopes, and other applications.

While Super-Polish gains notoriety for sub-angstrom proficiency, it does not have a standard industry-wide process. One widely used method is submerged polishing. In conventional polishing, optics mounted to a rotating spindle meet a lap moving back & forth polishing their surface. Abrasive slurries, adjusted based on particle size, are administered until a desired surface finish is achieved. Super-Polishing via the submerged technique, immerses the entire spindle/lap assembly into the polishing slurry. This protects the lap and optic from external contaminants that could damage the optical surface. Immersion also keeps the lap and optic at the same temperature, which improves shape consistency and promotes a smoother polished surface. Modifications to the submerged method include particle size distribution and monitoring slurry chemistry.



Green laser on optical table in a quantum optics laboratory

Super-Polish is used on a variety of hard materials like fused silica and sapphire. While most often the process is purposed for plano optics, it can be performed on spherical or aspherical surfaces and generally on any size optic.

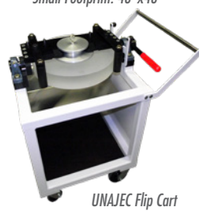
SUBMERGED CONTINUOUS POLISHER

Intricate Polishing Operations Rely On High Precision Performance

Specially engineered for Super-Polishing operations, the 29" Submerged Continuous Polisher from **UNAJEC**, is all about achieving low roughness targets and higher efficiency. An enclosed, precisely regulated environment locks out contaminants and maintains the needed consistency critical to delivering superior surface quality.

This polisher can run in submerged mode or with recirculating slurry; with pitch or pad. Multiple capacity workstations, a conditioner station, and stainless steel table are PLC controlled with touch screen HMI to precisely set RPMs from 2-35. Quick release capture arms allow for easy loading and unloading and swing away for accessible maintenance of pitch surface. A manual sky hook and mounted plate lift the conditioner and work in tandem with the **UNAJEC** Flip Cart to allow flatness inspection on the conditioner.

Small Footprint: 48"x48"



UNAJEC Flip Cart

This heavy duty, virtually maintenance free polisher will run uninterrupted 24 hour polishing cycles. Customizable features, including size, are available.

WHAT'S NEW...

Colloidal Silica

A commonly used abrasive, but with so many modifiable attributes, which is best for your application?

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ROBOTS & UAVs

From high-end sensors for visual inspections to aircraft cleaning, bots & drones are infiltrating aviation MROs.

Page 3

Ask An Expert: ON-SITE Q&A

Application engineers & polish technicians are on hand at every UPI/NUVITE trade show to address all surfacing questions.
For upcoming shows:
universalphotonics.com/events
nuvitechemical.com/events

OPTICAL GLASS: KEY TO AUTOMOTIVE INNOVATION

Properties of Optical Glass Deliver Efficiency & Performance to New Technologies

As the automotive industry looks to meet growing demands for road safety, driver assist systems, and improved vehicle comfort & aesthetics, glass continues to be a favored material for a number of reasons. Advancements in glass fabrication are satisfying a wide variety of industry innovations with optics to guide, reflect, select, and alter light. Moreover, glass optics have distinct physical properties that align with exacting automotive requirements for reliability and long service life.

An innovative concept 15 years ago, automotive LED lighting has evolved to create new systems of illumination for both interior and exterior. Rear Combination Lights (RCL) were among the first to take advantage of concentrating refracted light as a single source or an array of low power devices. Relying on the high thermal resistance and low expansion properties of glass, LED chips are packaged as groups with ever-smaller gaps to achieve greater luminosity. Designers can get more creative. Just look at the wide variety of taillights you see on the road today.

Matrix LED headlight systems combine with camera and image processing to control front light functions like glare-free and adaptive headlights. Adaptive Driving Beam (ADB) headlights keep high beams on while working in tandem with sensors. Objects in the road register as data, which processes to turn on/off altering light beams or dim various LEDs. There is no glare to oncoming traffic and the road is brightly and safely lit. There are a variety of automated front lighting systems. Some use indirect reflectors to produce beams; others are building a complex matrix of high-definition pixels for greater visibility and control. Anticipating driverless vehicles,

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DRYWASH: Meeting the Future Today

The Benefits of Waterless Cleaning Technology

Rarely does a product have advantages to benefit different market segments. DryWash is a deep cleaning technology that uses a chemical formulation to remove soil/oils/grease, deoxidize, enhance paint gloss, and provide a protective barrier against UV and other atmospheric conditions - All without water. It has become increasingly popular in the aviation industry, particularly since the elimination of water makes scheduling exterior cleaning flexible and convenient. During an eight-hour layover at a field base operation anywhere in the world, a full DryWash application on a wide-body aircraft facilitated in a hanger or on a ramp, can be completed while simultaneously undergoing other necessary maintenance activities. Moreover, DryWash can be adapted to surfaces by the extent, condition, and type of soil, making interim cleaning via area

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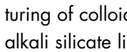
Colloidal Silica: HOW TO CHOOSE THE RIGHT ONE?

Silica, aka silicon dioxide, is the most abundant compound in the Earth's crust, accounting for 59% of its mass. It is the main constituent of beach sand and is present in 95% of known rocks. Silica is a main component in glass, as well as in construction materials for roads and buildings. It's also the mineral source for the element silicon, which enables the development of computers and many of today's modern electronics.

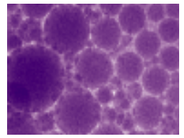
Colloidal silica is a commonly used abrasive in precision polishing. Industrially manufactured from synthetic amorphous silica, it can morph physical and chemical characteristics during the manufacturing process to yield different types of colloidal silica. The advantage is that varying attributes complement a variety of substrate applications. Understanding the science will help identify the right one for your polishing process.

A colloid is a stable dispersion of particles small enough that gravity does not cause them to settle out. Colloidal silica particles are typically in the range of about 5 to 120 nanometers (1000nm = 1µm). The most common method for high-volume manufacturing of colloidal silica slurry starts with an alkali silicate like sodium silicate. Using ion exchange, sodium is removed and replaced with hydrogen ions, forming silicic acid. Without the sodium, polymerization takes place. Particles begin to grow. Once the growth process is complete (heat and time), the final product is stabilized with additional chemical additives and concentrated to the desired content.

Colloidal silica is easily modified during the manufacturing process resulting in a variety of different products. For polishing, the properties most often modified are the median particle size, particle distribution, particle shape, surface charge and additive chemistry. Most colloidal silica polishing slurries have median particles sizes between 50-100 nanometers, however, both larger and smaller median size particles (5-120 nm) are commercially available. Another modifiable property is the distribution of particles. The manufacturing process is adapted to produce a narrow, unimodal distribution or a broader bimodal or trimodal distribution. For some processes, a bimodal distribution will enhance removal rate.

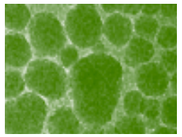


Unimodal: Particle Size Distribution



Bimodal / Trimodal Distribution

Particle shape is another property that is modified. Most colloidal silica particles are spherical, but certain applications benefit from an oblong shaped particle (think potato shape).



Non-spherical shaped particles

Surface chemistry can be modified also. Colloidal systems are often very sensitive. If not managed properly, they can flocculate and settle out or even gel. Applying different surface chemistry can stabilize and make them usable in acidic, neutral or basic conditions. The most common colloidal silica slurry used for polishing optical materials has a pH of 9-10. Beside pH stability surface chemistry, colloidal silica slurries can be modified for specific applications. They are often used in CMP (Chemical Mechanical Polishing/ planarization) processes with additional chemistry to speed up surface removal rate. These chemical additives enable colloidal silica slurries to polish hard substrates like sapphire and silicon carbide.

With so many modifiable attributes - size, distribution, shape, chemistry - finding the right colloidal silica slurry is challenging. The most common have a pH of 9-10, and a median particle size between 50-80 nanometers. With either narrow or broad particle size distribution, this type works well in most optical fabrication polishing processes. For substrates like metal, a lower pH colloidal silica slurry might be a better choice. Harder substrates like sapphire or silicon carbide do better with a colloidal silica that has special chemical additives to enhance removal rate. Silicon, gallium arsenide, gallium nitride, and other like substrates may require special formulations. Contact a **UPI** applications engineer to discuss the right colloidal for your process.

DryWash:

Waterless Cleaning Technology

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wipe downs quick and efficient. Its targeted surface application helps identify signs of wear, corrosion, and metal fatigue, all required checks for safety compliance.

A well-formulated DryWash system deep cleans irregular surfaces, depositing an added barrier against paint deterioration and inhibiting further oxidation, soiling and stains. The protective coating it leaves further guards against UV and other atmospheric degradation. DryWash technology reconditions the surface enhancing gloss appearance and intensifies the vibrant color of an aircraft's paint. A shiny livery reinforces brand recognition and is known to impress passengers as air worthy; both solid pluses for operators.

Anticipating enormous increases in air travel over the next several years, airports worldwide are examining infrastructure with sustainable water management as a top priority. The extraordinarily large amount of water airports depend on is forcing stricter conservation policies. In addition, wastewater and runoff from land-based operations like deicing, fuel spills, and wet wash pits, can cause very real problems with groundwater and soil contamination. Repurposing via capture and/or treatment is essential, but expensive. With more airports restricting wet washing, DryWash is the perfect solution. Its waterless application deftly addresses airport concerns for conservation and environmental compliance.

NUVITE Chemical Compounds offers a selection of high-quality DryWash products. Choose from **NuPol**, **NuPower II**, **Citri-Cut Xtra**, or **NPC/3**. Engineered to clean, condition, protect, enhance and improve the longevity of your aircraft's appearance, each has attributes to meet specific surface conditions. Contact an applications engineer to find which **NUVITE** DryWash will deliver the best results for you.

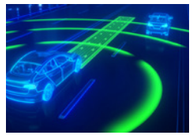
OPTICAL GLASS & AUTOMOTIVE: *Meeting the Challenges of New Technologies*

...Continued from page 1

a MEMS-based system will consider lasers. These systems all use an LED light source and rely on components with high transmittance, making optical glass an excellent material choice.

High-precision glass is malleable with seemingly unlimited configurations. Many automotive applications rely on high-precision glass molding technology for the wide variety of aspheric lenses the process produces. LED, laser lighting, pico-projector lenses, Head-Up Displays (HUD), infrared devices, video surveillance (CCTV) and more are developed using aspherical lenses from different types of optical glass. From LED to fiber optic technology, optical glass is redefining functional and ambient light to both assist and enhance the driving experience. Instrument panels, map lights, center consoles, door panels, even exterior signature lighting depend on the growing capabilities of optic fabrication to realize unique, branded designs.

As driver assist systems become intrinsic to our driving culture and autonomous vehicles take to the road, reliability is key. Blind spot detection, pre-crash warning, parking assist, lane departure, night vision, adaptive cruise control, intelligent light control, and traffic sign recognition rely on the performance of a multitude of optical components. Fortunately, optical glass has good chemical resistance and is immune to many aging factors like corrosion and yellowing, assuring assist systems extended life.



"Many innovations we see today, from the standpoint of driver assist systems and comfort, are being rolled-out on premium vehicles," says Troy Alley, Sr. Applications Engineer of **UNIVERSAL PHOTONICS**. "Cost may be a factor, but as production catches up with technology we'll see subcompact cars with the latest equipment as well." Mr. Alley also represents **UPI**'s North American distributorship of **CDGM**, the world's largest producer of optical glass. The **CDGM** portfolio has 240+ types of glass in a wide variety of forms, as well as specialty glass for lighting, electronics, and custom applications.

BOTS Looking to Change the MRO INDUSTRY

Automation via robotics and UAVs has infiltrated industry worldwide. While robots have been on the automotive production line for decades, the technology has had a much slower build in aviation. Partly due to high safety standards and lower manufacturing volumes, robotics (bots) showed up only a few years ago on the production floor, charged with repetitive riveting of Boeing's fuselage sections and hole-drilling for Airbus.

Today, robots continue to inch their way into aircraft Maintenance, Repair & Overhaul (MRO) operations. As the technologies improve, the list of suitable tasks for bots grows; from high-end sensors performing visual inspections of exterior surfaces for damage and wear, to automated aircraft washing bots. Aerowash, a Swedish company specializing in robots that clean any size and shape aircraft, claims to shorten the wash process 60%. Its newest model was approved for all Airbus aircraft with its first demo system scheduled for delivery this year. New Zealand's Invert Robotics produces mobile climbing robots that adhere upside down to wet, dirty and dusty surfaces. Targeted for visual inspections and cleaning applications, the latest bot platform is expected to roll-out next year. While complying with rigorous safety regulations complicates automation, many MROs, along with third-party developers, continue promoting robotic innovation.

UPI SPOTLIGHT

THE HILCO STORY:

Discovering a Diamond in Our Own Backyard

In the early pages of his new book, author Art Hilsinger, Jr., presents three questions. The first, *is this story of interest to anyone other than the writer?* It certainly should be for any entrepreneur supporting an established company profile, facing inevitable change. The HILCO Story tracks the sixty-three year journey of a company founded by a patent-holding inventor and company namesake, Arthur R. Hilsinger Sr.; a craftsman, Herbert "Pete" Nelson; and a young salesman, Art Hilsinger Jr. Relying on a complement of talent and extensive connections in the optical industry, the Hilsinger Corporation identified as a contract manufacturer. While the early years chalked up some success, the emphasis on manufacturing may have pigeonholed output along with its supporting resources. A bright light was a flagship product, the HILCO Holder eyeglass chains. As the company grew the proprietary "HILCO" brand served as a banner for other popular products and services.

Answering the next question - *has this story been told before?* - best relies on the writer's candid retelling. A company reinventing itself is nothing new, but as a firsthand account of a company maneuvering in and out of a manufacturing mindset amidst decades of change, it's an engaging story. From shifting contract components, the retooling of Evans Lighter & Gift to Eyecessories, and the ever-expanding HILCO line, the story steers through rollercoaster changes including a Surgeon General's warning, EPA updates, fluctuating profitability and debt, laser eye surgery, and globalism.

And finally: *is the writer the best person to tell this story?* As one of its original founders and a key driver to "becoming the best niche company in the optical world," Art understood the benefits of replacing a current idea, product, or service with a better one. Beginning with the original HILCO Holder, the Hilsinger Corporation continued to provide creative and everyday products and services for the optical retail and wholesale communities. It was a bold move that Art took to find that diamond in his own backyard.

While the company has morphed many times since Art's retirement in 1997, today HILCO Vision continues to serve the optical community with new products and innovative solutions.