SURFACING SCIENCE

www.universalphotonics.com | EMAIL: info@universalphotonics.com | UNIVERSAL PHOTONICS ADVANCED SURFACING PRODUCTS & TECHNOLOGY | VOLUME 3

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

HONG KONG
T: +852 9456 8628

CHINA: NANJING
T: +86 25 5287 6893

CHINA: SHENZHEN
T: +86 755 2584 9294

KOREA
T: +82 31 217 5873

TAIWAN
T: +886 6505 2996

LABORATORY CLIFFHANGERS: What a dinosaur teaches us...

Interesting thing about dinosaurs is that with each "dig" there's opportunity for discovery. It's like that for a formulation chemist inspired by digging into a bank of *old world knowledge*. Innovation builds on the foundation of previous accomplishments, failures, and mistakes, promoting a qualitative and quantitative approach to new and exciting formulations. Case in point - NUVITE's NPC/3. With low odor and minimal dust, NPC/3 is the next generation of waterless drywash, primed for wipe-on/wipe-off application on newer paint formulations for composite or metal substrates.

For nearly 70 years, NUVITE laboratories have been creating appearance maintenance products to meet customer needs and contemporary objectives. In the 1970's, mounting regulations obliged product development to ensure health & safety to both worker and environment. As it did then, an occasional dig into the NUVITE archives of proprietary formulations continues to deliver dynamic products that are high-performing (and compliant) to numerous markets including aviation & aerospace, automotive, marine, industrial, and institutional. NPC/3 is the answer to the call from major airlines for a high performance, waterless, drywash that is environmentally safe, emits low odor during application, generates minimal dust during removal, and deposits a protective coating. To meet these specs, inspiration came from NuPower II, NUVITE's cleaning and polishing, drywash work horse. With this as a base, and combining today's raw material advancements with high-tech process efficiency, NPC/3 delivers a 3-in-1 function to clean/deoxidize, preserve, and protect in one application. As a division of UNIVERSAL PHOTONICS, NUVITE's access to UPI's lab facilities, chemists, and engineers, along with a fully stocked resource database yields a combination of *old world understanding* with *new world innovation,* ensuring there will always be a new dig underway.

NUVITE ON THE SURFACE: STRUCTURAL MATERIALS & OEM REQUIREMENTS

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Weight reduction is the single greatest advantage of composite material usage because it directly translates to fuel savings. Fiber-reinforced matrix systems are stronger and hold up well in structural flexing environments. But because composite materials don't break easily, its harder to tell if the interior structure has been damaged. In contrast, aluminum bends and dents, making detecting structural damage easier.

No matter the material, keeping an aircraft in pristine condition is critical to safety and supports public perception. Typically, all aircraft are finished with a protective coating, which is often a gel coat, pigmented paint coat, or clear coat. Besides providing an added layer of protection, painted aircraft surfaces differentiate airlines and uniquely sell the individual brand.

Planes need to be cleaned and polished, as oxidation and corrosion will damage an aircraft's structure. Aircraft manufacturers like Boeing and Airbus have specifications for what chemicals can be used on the exterior of their planes without damaging the underlying structure. NUVITE's full line of exterior appearance maintenance products comply with all standard requirements of Original Equipment Manufacturer (OEM) specifications. The paint care line, a graded system of products, works safely on aircraft coatings and fabric materials, new or aged. Contact a NUVITE technician to find the product that will meet your specific maintenance needs.

WHAT'S NEW...

ALUMINA:
WHY IT PAYS TO KNOW HOW IT'S PROCESSED...

Widely used in hundreds of applications, which is the right one for your application? ***Page 2***

RARE EARTH ELEMENTS
Keeping an Eye on Market Trends

China takes steps to secure its control of the REE market. ***Page 3***

INTRODUCING

Technically advanced products for critical surfacing applications make their debut.

HASTILITE FIN, CeO_2 polishing slurry delivers top performance with easier cleanup.

LCL BLUE and **LCL BLACK**, Next generation lens coating with reduced VOCs and REACH/GHS compliance. ***Page 2***

Ask An Expert: ON-SITE Q&A

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

COLD BLOCKING

The Solution to Post DeBlock Deformation

Many optics manufacturers struggle with changes to part flatness once the parts are removed from the blocking tool. Familiarly known as *post deblock deformation*, the result is very often failing surface flatness. UPI has investigated a number of fixes beginning with a new series of "low stress" waxes that are stiffer and have lower melting points to keep parts from shifting. The UPI solution, aptly called the *Cold Blocking Technique,* makes best use of **UPI's Low Spring Wax** and minimal heat stress so parts maintain parallelism, form, and figure even after deblocking.

The *Cold Blocking Technique* strategically places parts

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NUVITE ON THE SURFACE: STRUCTURAL MATERIALS & OEM REQUIREMENTS

Today, carbon composite is the ultimate material in structural aviation. And while composites have been used since the 1970s, it's only been in the last decade that long-haul commercial plane models like the Boeing 787 Dreamliner and Airbus A350 have begun replacing metal parts with lighter carbon. Why?

UPI EXPANDS LINE OF POLISHING MATERIALS

Acquires J.I. MORRIS Polishing Textiles

UNIVERSAL PHOTONICS has acquired J.I. Morris Company's surface polishing pads and materials business. The J.I. Morris Company with more than 75 years of professional experience developing materials to improve surface finishes offers a broad range of high quality polishing discs, pads, and uncut fabric for industrial applications.

J.I. Morris Company's high quality products and services fit well into UPI's polishing material business. The acquisition expands UPI's ability to meet specialized customer applications with an even larger variety of pad materials and technology.

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These wide-bodied, twin-engine aircrafts are extremely expensive to make. The Airbus A350 for example, which seats 280 to 366 passengers, has development costs estimated at $15 billion. And for the development of the 787 Dreamliner, with 242 to 335 seats, Boeing spent a reported $32 billion. Carbon composite material, or carbon fiber, is significantly pricier than its predecessor material aluminum alloy or fiberglass. However, carbon composite does have advantages.

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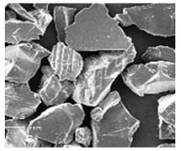
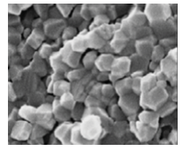
ALUMINA:

Understanding How the Manufacturing Process Supports Critical Surfacing





ALUMINA Particles:
(l) FUSED (r) CALCINED

Aluminum oxide (a.k.a alumina or corundum) is widely used as a raw material in hundreds of applications. Particularly popular in surface finishing operations for materials like metals, sapphire, glass, plastic, and other optical substrates, there are many types of alumina from which to choose. Deciding which – brown, white, fused, calcined, colloidal, fumed, etc. - to use for specific materials or surface finishing steps can be confusing. Here's why it pays to know a little about the manufacturing processes of alumina.

Alumina, derived from aluminum hydroxide, is the main component of the mineral bauxite. While most mined and processed bauxite becomes the metal aluminum, manufacturers recognize the significant demand for alumina chemicals in ceramics, abrasives, sapphire and many other applications. Different manufacturing processes ensure targeted results such as purity, particle shape, reactivity, costs, etc. In turn, we take advantage of the resulting alumina products from these variant manufacturing processes to optimize our own surface finishing operations. The most widely used of these are *fused* and *calcined* alumina.

Produced in electric arc furnaces at temperatures above 2000°C, brown and white aluminas are the most common coming out of the fused manufacturing process. Brown fused alumina is produced from bauxite combined with additives, while white comes from fusing calcined alumina. Because of the high processing temperature, fused alumina products are always alpha alumina particles (also known as corundum). Fused alumina products are then grinded, milled and separated into different particle sizes.

Calcined alumina, derived from thermal treatment of aluminum hydroxide (or other aluminum compounds), is typically carried out in rotary or tunnel kilns at temperatures of 800°C to 1500°C. Unlike fused alumina, calcined alumina is processed at lower temperatures allowing controlled transition rates from phases like gamma alumina to fully converted alpha alumina. Controlling the temperature also controls the growth of the crystallite size. Calcined alumina is basically agglomerates of crystallites, which typically vary from 0.1 to 10 µm. The greater the degree of calcination, the bigger the crystallites will be. Similar to fused alumina, calcined alumina is grinded and separated into different particle sizes. Choosing fused, calcined, alpha, gamma or some other type of alumina for each step in the surfacing process is vital. Particles derived from the fused process have very sharp, angular edges, which generally will not break down during polishing. Since they generally deliver higher removal rates than calcined particles, fused particles are often used in grinding and lapping applications (including in fixed and bonded abrasives). The downside? These hard, angular surfaces of fused particles induce more surface damage. This is why calcined alumina, with less angular edges and greater ability to break down into smaller particles sizes, are preferred during the polishing steps of the process. Both fused and calcined alumina products are available in a variety of particle sizes to optimize each step.

In addition to fused and calcined, there are other alumina processes used in surface finishing operations such as colloidal and fumed alumina. These processes produce very small alumina particles with different particle shapes, which typically have applications in final polishing steps.

With all the different alumina choices available, count on the experienced UPI sales and engineering team to help you determine the best alumina size and process for your surface finishing application.

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The business will operate out of UNIVERSAL PHOTONICS' ISO-9001:2008 certified manufacturing facility, JH Rhodes, in Vernon, NY. A subsidiary of UPI, JH Rhodes specializes in manufacturing polishing pads, typically for glass, crystal, metal, and ceramic applications.

J.I. Morris' substantial inventory includes standard and custom fabrics of natural fiber, synthetic, and a variety of blends. The sizeable stock allows nearly all style queries to find a match and all are available in die-cut polishing discs & pad shapes, or as uncut goods. Custom cutting of polishing discs and shapes, as well as custom dies, are possible to specific configurations for optimum compatibility with unique finishing processes. For more information visit www.universal-photonics.com.

NOW LAUNCHING

HASTILITE FIN is the latest addition to the HASTILITE line of ultra-high quality, liquid polishing slurries uniquely engineered to produce critical surfaces not attainable by conventional polishing materials. **HASTILITE FIN**'s enhanced properties deliver higher removal rate in faster processing time to return exceptional surface finish. Its improved suspension formula contains special cleaning agents, making cleanup of parts and tools quick and easy.

LCL BLUE and **LCL BLACK** are the next generation of lens coatings providing a quick drying, hard protective coating for optic processing. What makes these coatings particularly attractive is the reduction of VOCs and elimination of phthalates in accordance with REACH/GHS directives. Choice of color, blue or black, indicates application area and assists in surface analysis.

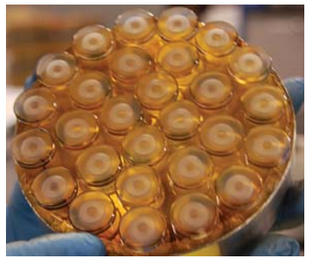
RARE EARTH MARKET TRENDS - *Keeping a Watchful Eye*

The fact that mineable supplies of rare earth elements are heavily concentrated in certain geographies and that there is a growing demand for REE from countries across the globe, is reason enough for UNIVERSAL PHOTONICS to continually monitor REE market trends worldwide. We all recall the rare earth crisis a few years ago, when in a matter of weeks, prices increased by more than an order of magnitude and availability became at best uncertain. Cerium oxide, one of the rare earths used extensively in polishing applications by a broad base of our customers, was threatened by supply outages. Relying on our extensive Asian network, UPI was able to provide real-time updates and information on pricing and availability of raw materials to lessen the impact on production.

Today, China produces more than 85% of the global supply and is the largest consumer of REE. Since 2015, China has taken steps to secure its control of the REE market, stockpiling and holding more reserves than other countries, with levels approximately 30x greater than the USA. Furthermore, consolidating authorized suppliers into six large companies helps China stabilize price, manage reserves, and forecast its future needs, predicted to increase in their pursuit of clean energy.

While pricing and supply for 99.9% min. cerium oxide have remained stable, we're seeing a measurable uptick in raw material prices climbing to 15,500 RMB per metric ton in October, a 40% increase over January 2017. This does not reflect price increases for the final product, since there are many processing steps required to bring raw cerium oxide to the final state used in polishing. We expect a small increase in the sell price of lower priced cerium, which requires less processing making the raw material a larger percentage of the final cost, and little to no increase in the higher end polishes. Availability does not appear to be a concern at this time. We do not know if this is an indication of things to come or just a short term bubble, but UPI will continue to monitor the situation and keep you posted should there be any significant movement.

COLD BLOCKING *The Solution to Post DeBlock Deformation*



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on an optically flat blocking plate fitted with a layer of stretched silkscreen. Using the known flatness of the blocking plate creates a starting plane for the parts. The parts are transferred from the silkscreen blocking plate to a pre-made cold block wax tool. Once blocked, the parts are gently lifted from the silkscreen blocking plate and moved directly to polishing operations. During the polishing process, parts quickly take uniform shape and flatness control begins with minimum material removal. Throughout the blocking process there is minimal heat and stress, so parts suffer no negative effects.

Once the polishing process is complete we're ready to deblock. Cleaned part surfaces are covered with a protective coating. UPI offers several protection options including **LCL Blue** and **LCL Black**, two new hard coatings with reduced VOCs and REACH/GHS compliance. With parts coated, the entire block is placed in freezer for two hours. The **Low Spring Wax** will freeze and fracture, allowing parts to be easily removed. All materials can resourcefully transition to the cleaning process.

Savings are inherent with the *Cold Blocking Technique*. Slight scratches, bad coatings, surface figure are just a few reasons parts fail inspection. A quick and inexpensive process, *Cold Blocking* is an excellent option for single surface rework scenarios. The technique allows for total thickness variation (TTV) to exist in the part batch, while allowing smooth transition into polishing without re-lapping. Manufacturers of flat surface optical components will find the most benefit in this technique, particularly for critical aspect ratios and very large clear aperture call outs. Applying the *Cold Blocking Technique* with a double-sided polishing operation is a great way to approach a secondary finish requirement on a single surface with more stringent tolerances. Our process engineers will be glad to further explain UPI's *Cold Blocking Technique* and how it best works with your application. 516.935.4000

UPI SPOTLIGHT

Optic & Electronic Koch GmbH

For nearly two decades, *Optic & Electronic Koch GmbH* has built and continues to maintain a stellar reputation as a major supplier of UPI products to the photonics industry in Europe. The association with UPI goes back to the late 1980's, when Rudi Koch, the company's founder, was sourcing consumables for RGB Bijnens. Ten years later, striking out on his own and appreciating the UPI commitment to technically advanced critical surfacing materials, Rudi opened his business with UPI products at the core. A family run operation, *Optic & Electronic Koch GmbH* successfully grew their startup focusing on precision optics and photonics.

Today, with Nils Koch, Rudi's son and Managing Director, at the helm, the company commands an impressive share of the optics market in the DACH region of Europe, an area comprised of Germany (D), Austria (A), and Switzerland (CH). Working in concert with UPI application engineers, the company supplies product and technical support for a wide range of optics, from spherical and Plano to nanolithography and IR applications, to name just a few. *Optic & Electronic Koch GmbH* is positioned for continued growth with opportunities in Scandinavia, Poland and other areas in the EU. While Rudi's passed the baton, his expertise in the optics field, keeps him a vital member of the team.