Ceramic & Glass MANUFACTURING

APRIL 2023 • VOLUME 4 • ISSUE 1

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MANAGING THE GREAT RESIGNATION, BABY BOOMER RETIREMENTS, AND TODAY'S LABOR MARKET

TWO UNIVERSITIES EXPAND CERAMIC ENGINEERING PROGRAMS

HOW TO FIND, KEEP, AND DEVELOP TECH TALENT

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CONTENTS

Ceramic & Glass MANUFACTURING

Vol. 4, Iss. 1

Editorial & Advertising Offices
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Westerville, OH 43082

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INDUSTRY NEWS

KYOCERA PLANS RECORD INVESTMENTS IN JAPAN

Kyocera Corp. plans to build a manufacturing plant in Isahaya City, Japan, and plans to acquire about 37 acres in the Minami Isahaya Industrial Park there. The company says its capital investment in Japan is expected to reach a record high in the current fiscal year, mainly due to strong demand for components related to advanced semiconductors. Kyocera is planning even higher levels of investment in fiscal year 2024 and beyond, in addition to increasing production capacity in both Japan and internationally.


Kyocera says its existing campuses have little or no room to expand.


Shinagawa plans to strengthen its nonrefractories business globally.

SHINAGAWA ACQUIRES SAINT-GOBAIN BUSINESS UNITS

Shinagawa Refractories Co., Ltd. completed the acquisition of Saint-Gobain's Brazilian refractories business and its alumina-based, wear-resistant ceramics business in the United States. Shinagawa has supplied technology for Saint-Gobain's manufacture of iron and steel refractory products in Brazil since 1991. The acquisition of the wear-resistant ceramics business represents a new non-refractories product offering for Shinagawa in the U.S.

NGK ADDS SOLAR POWER TO MANUFACTURING PLANTS

NGK Insulators, Ltd. will install photovoltaic equipment with a total capacity of 40 MW at its manufacturing sites in Japan, Poland, Thailand, and elsewhere by fiscal year 2025. The renewable energy plan will cut its annual carbon dioxide emissions by 22,000 tons, the company says. NGK plans to achieve net zero CO_2 emissions by 2050. The group is also developing technology for manufacturing ceramics using clean energy sources that do not emit CO_2, such as hydrogen and ammonia.


NGK produces ceramic products for the automotive, energy, telecommunications, and other industries.

AMI's new innovation center in Houston, Texas.

NEW R&D CENTER OPENED BY AMI

Active Minerals International opened a state-of-the-art research and development innovation center in Houston, Texas. AMI produces air float kaolin and gellant attapulgite, and the company says the new center will lead technical innovations in products, processes, and application developments. Research includes particle morphology study, mineral phase analysis, particle size measurement, and rheology study. The center will be run under the direction of AMI vice president of research and development Bo Wang.

RHI MAGNESITA ACQUIRES REFRACTORY PRODUCER IN CHINA

RHI Magnesita acquired a majority share of Jinan New Emei Industries Co., Ltd., a leading producer of refractories in China. Jinan New Emei produces refractory slide gate plates and systems, nozzles, and mixes for use in steel flow control. It employs more than 1,300 people and is headquartered in Shandong province. RHI Magnesita says it expects to realize substantial synergies from the combination of Jinan New Emei with its existing refractory business in China.

The acquisition will allow RHI Magnesita to increase the supply of refractories in both China and the wider East Asia region. *Photo: RHI Magnesita*

The EU plans to install more than 320 GW of new solar photovoltaic capacity by 2025. *Photo: Guillaume Périgois on Unsplash*

EU FORMS SOLAR MANUFACTURING ALLIANCE

The European Commission launched the European Solar PV Industry Alliance to secure diversification of supplies through more diverse imports and scale up solar photovoltaic manufacturing in the European Union. The Commission says the alliance is an essential component of the REPowerEU plan, which aims to scale up and speed the production of renewable energy in Europe to gain independence from Russian fossil fuels, and make the EU's energy system more resilient.

SCHOTT OPENS US FACILITY FOR LIFE SCIENCES PRODUCTS

Schott opened its first facility in the U.S. to increase capacity to develop and manufacture diagnostics and life sciences products. The multimillion-dollar investment in a 40,000-square-foot facility in Phoenix, Ariz., will focus on production of custom DNA and protein biosensors and other microarrays on glass, semiconductors, and polymer microfluidic consumable devices. The expansion will create 150 new jobs over the next few years.

Phoenix mayor Kate Gallego, center, and Schott senior executives celebrate the opening of the Phoenix facility. *Photo: Schott*

Pittsburgh-based HWI is the largest refractory products and services supplier in North America.

PRIVATE INVESTMENT FIRM ACQUIRES HWI

HarbisonWalker International (HWI), a provider of refractory products and services, announced that it agreed to be acquired by investment firm Platinum Equity. Financial terms were not disclosed. In 2022, Platinum Equity acquired Imerys S.A.'s high-temperature solutions (HTS) business, a provider of refractory solutions serving more than 6,000 customers in Europe and Asia. Platinum Equity says it plans to combine HWI and HTS into a global business. Founded in 1995 by Tom Gores, Platinum Equity has approximately $36 billion of assets under management and a portfolio of approximately 50 operating companies.

MANAGING THE GREAT RESIGNATION, BABY BOOMER RETIREMENTS, AND TODAY'S LABOR MARKET

By David Holthaus

Spurred on in part by the pandemic, more than 47 million people quit their jobs in 2021, a mass exodus from the workforce that has become known as The Great Resignation. The unprecedented movement exacerbated an already severe labor shortage that employers have been coping with for years.

The post-pandemic exodus was not merely a one-time phenomenon but was the continuation of a long-term trend. For a decade, each year from 2009 to 2019, the percentage of people leaving the workforce increased, according to the Bureau of Labor Statistics. That number declined in 2020, as the uncertainties surrounding the pandemic caused workers to hang on to their jobs and paychecks. But it returned in a big way in 2021, as people reevaluated their lives, their work, and their purpose.

With post-pandemic U.S. unemployment already well below the traditional "full employment" threshold since December 2021, and at low levels not seen in decades, employers have turned to new strategies to not only find workers but to keep them.

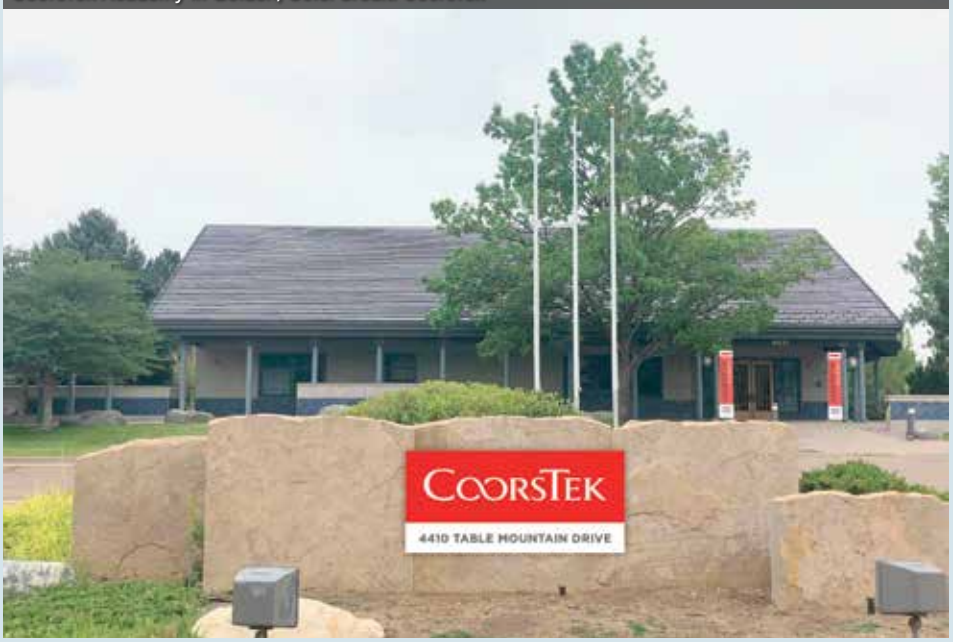
CoorsTek is a global manufacturer of engineered ceramics, with more than 6,000 employees at more than 30 facilities across three continents. Maintaining a pipeline of well-trained talent is critical to its ongoing success, and the company has developed connections with engineering and technical schools so it can provide feedback on industry needs and help develop curricula to train the future workforce of advanced manufacturing, says Emily Lundi-Mallett, CoorsTek's vice president of talent management.

A teaching session in progress at CoorsTek Academy. *Credit: CoorsTek*

The company is working with a career and technical education center in Benton, Ark., for example, on developing ceramic materials courses. CoorsTek operates a manufacturing facility there that has been expanded in recent years.

The company will be closely involved in the development and implementation of the courses.

"We'll bring the ceramics piece to it," Lundi-Mallett says. "We can start to ignite and spark some interest in their students."



CoorsTek Academy in Golden, Colo. *Credit: CoorsTek*

The Golden, Colo.-based company has a longstanding relationship with Colorado School of Mines in Golden, a partnership that has included funding the CoorsTek Center for Applied Science and Engineering, a 95,000-square-foot facility that supports a range of academic and research activities on the Mines campus. The company is also partnering with other engineering-centric schools across the country, including Alfred University in New York and Kettering University in Flint, Mich.

"Part of our reach outward is to make sure we have those schools tapped, we have relationships built, we're partnering with them with education and providing internships and entry into CoorsTek," she says.

Finding and hiring qualified talent is just part of the workforce puzzle today. Keeping them is the other part. To help foster long-term employee engagement, CoorsTek started CoorsTek Academy, a two-week, immersive onboarding experience for new employees. In the first week, new hires learn about the company, its history, its culture, its markets, and hear from different representatives across the company's disciplines and functions. In the second week, new employees begin to get introduced to their roles, learning through job shadowing, mentoring, and training.

Technical trainers help with skills assessments and instruction so new employees can start their jobs feeling ready and supported. The Academy experience also serves to improve productivity.

"We give them a deep understanding of what will be expected of them," Lundi-Mallett says. "When they start on the job, they hit the ground running. It helps accelerate their productivity."

Last year was the first full year of implementation for the Academy, and all new employees now take part in the process. The reception has been very good, Lundi-Mallett says, as new employees feel engaged and welcomed.

"They are a little bit blown away," she says. "They love that we are investing that much time in them."

She adds, "It sets them up for success because in the second week they get to actually experience and see what it's going to be like when they're standing in front of the machine or working inside of a plant."

The company also helps employees envision a future for themselves, as it conducts skills assessments and helps develop career opportunities within the company.

"We want to build our technical acumen internally so people can see the multiple career paths they have within CoorsTek," Lundi-Mallett says.

At Corning Inc., the New York-based glass and ceramics technology company that employs more than 60,000 people, tapping into next-generation talent is critical. The company has a well-established, competitive internship program that expands its access to science and engineering students.

The company receives thousands of applications each year for 300 internships in the U.S. On average, science and engineering internships account for 75% to 80% of Corning's total summer intern hires in the U.S., the company says. The company also offers similar internship opportunities globally.

Students are assigned to projects that align with their coursework, help solve some of the company's challenges, and provide experiences they can apply in future careers. Students are also assigned to a manager and paired with a mentor who is available to help guide the student and frame the deliverables for each summer project. At

Stevanato Group is expanding production of its EZ Fill vials and syringes in Italy, China, and the U.S. *Credit: Stevanato Group*

the end of the summer, students present their project, key findings, and lessons learned during a poster session for Corning's Technology Community.

Typically, approximately a third of interns in the U.S. transition to full-time positions after graduation, Corning says. If the student is a rising junior or decides to move into a graduate or doctorate program, Corning will often invite students back for a second, or possibly a third internship.

The program is one of the largest sources for identifying early-stage talent for Corning's technology community.

Finding and keeping talent is also essential to the growth of Stevanato Group, a leading global provider of drug containment, drug delivery, and diagnostic solutions to the pharmaceutical, biotechnology, and life sciences industries. The company employs more than 5,000 people globally and is rapidly expanding, with new manufacturing facilities now under way in Latina, Italy; Zhangjiagang, China; and Fishers, Ind.

So far, the company has navigated the talent marketplace partly by being competitive with compensation, but that is not its only approach, says Riccardo Butta, president of Stevanato's Americas division.

"We are not trying to steal people from other companies simply over pay; that's not a good practice," he says.

Rather, the company fosters long-term engagement with its employees, partly through training.

"We want to add stability to the organization," Butta says. "It's knowledge that you want to retain. We want to invest in the long term."

The company also promotes its culture and history as a firm started by the Stevanato family in the 1940s and now traded on the New York Stock Exchange.

"We talk about and live our values and guiding principles," Butta says. "That helps people to engage and see the value of the company and create the environment that you need to have if you want to retain people over time."

The company is also very conscious of promoting diversity in its hiring, he says, as a diverse management and workforce improves competitiveness.

"Not only gender and race, but also cultural diversity," he says.

Colleagues from the company's operations in Mexico, Brazil, and China rotate into positions at the home office in Italy, and have been added to the core team that is beginning to staff the new plant in Indiana.

"It's something that will create value for the company in the long run," Butta says.

Two universities expand ceramic engineering programs

By David Holthaus

How times have changed.

A few decades ago, 14 U.S. colleges offered undergraduate degrees in ceramic engineering. That's now down to two.

Beginning this year, make it three.

The Colorado School of Mines this fall will formally launch a bachelor of science degree program in ceramic engineering, helping to fill a growing demand.

"There's a huge need for ceramic engineers, and demand is significantly outpacing supply," says Brian Gorman, professor of metallurgical and materials engineering at Mines.

Brian Gorman

Additionally, at South Dakota School of Mines, a minor in ceramic engineering was added to that school's curriculum last fall semester.

"We were looking at some of the roles that our students were getting into, and we saw that there was a knowledge gap in those materials," says Michael West, head of the materials and metallurgical engineering department at South Dakota.

The coursework could develop into a ceramic engineering major in the future, he says.

The additions at the two schools are in response to feedback from industry.

"We actually brought some of our industrial partners to campus and asked them, 'What do you need from our graduates? What skills do you want them to have?'" Gorman says. "And so we built the program around those interactions."

Those partners include CoorsTek Inc., one of the largest manufacturers of technical ceramics, which is headquartered just a few blocks away from the school in Golden, Colo., and Johns Manville, the Denver-based maker of insulation and other industrial materials.

The ceramic engineering program at Colorado will build on the university's expertise in materials science and engineering, as well as make use of its ceramics research facilities, including an on-campus glass hot shop. Students will be prepared to work in industries including semiconductors and electronics, defense, renewable and traditional energy, household goods, automotive, aerospace, and more.

South Dakota has good relationships with companies in the steel industry, and other sectors that have a demand for specialties in refractory science, West says. After attending trade shows, including Ceramics Expo and the annual Materials Science & Technology exhibition, West and his colleagues came away with a better understanding of industry needs, he says.

Colorado Mines actually had a "soft kickoff" of its new program in the 2023 winter semester, as 10 juniors majoring in metallurgy switched to ceramic engineering and will graduate with that degree in 2024. The first full class of ceramic engineering majors will start in the fall.

The undergraduate students will receive hands-on training in ceramic processing; sintering; glass science; and thermal, mechanical, and electrical properties, Gorman says. Four core laboratory classes starting in the students' second year will provide hands-on experience with the materials, and students will also have access to undergraduate research opportunities and makerspaces.

Students at Colorado School of Mines will have access to research opportunities and makerspaces, including Mines' on-campus glass hot shop. *Credit: Colorado School of Mines*

The graduates from these programs are sure to be welcome in industries that have a need for such specialty talent in engineering.

"That's our number-one goal as educators, to put out a well-educated, capable workforce," Gorman says.

HOW TO FIND, KEEP, AND DEVELOP TECH TALENT

By Sven Blumberg, Ranja Reda Kuba, Suman Thareja, and Anna Wiesinger

The full version of this McKinsey article was originally published on McKinsey.com on April 14, 2022. It can be found at mckinsey.com/capabilities/mckinsey-digital. Republished with permission.

Editor's note: While this article focuses on coders, developers, and engineers in the tech industry, we felt the information translates equally to other industries reliant on technical talent to drive innovation, such as the ceramic and glass industry.

The Great Attrition is being felt in many companies as tech talent streams out the door to pursue better opportunities. Being able to work remotely has made it even easier for people to leave because geography is less of a barrier to poaching talent.

For many companies, these moves come with a big warning: there is a massive push happening to grab talent, and you may be missing out.

These seismic shifts come at a time when the shortfall for tech talent is already acute. Our analysis shows that significant skill gaps exist in seven areas, and we expect them to become more severe over time.

Business leaders are feeling the heat. According to a McKinsey survey of more than 1,500 senior executives globally, some 87% say their companies are not adequately prepared to address the skill gap. And according to another McKinsey survey, 61% of HR professionals believe hiring developers will be their biggest challenge in the years ahead.

Despite the formidable challenges in finding tech talent, incumbent companies cannot expect to succeed in the digital world without being technologically strong, which is simply not possible without a deep bench of tech talent. In fact, developing robust people and talent strategies are among the highest-value actions a business can take. Tech talent, therefore, should be a CEO's top priority.

Based on our work on more than 80 technology-talent transformations, we have identified a set of 10 realities companies need to face and what they can do to address them.

YOU CAN'T BE GOOD AT JUST ONE ASPECT OF TALENT MANAGEMENT AND EXPECT TO SUCCEED

Fulfilling your tech-talent needs is increasingly a multifaceted contest. Finding great talent does not help if the talent does not want to work for you, and hiring great talent does not matter if the talent leaves quickly. Companies have to invest simultaneously across the entire "hire-to-retire" life cycle.

That starts with developing a digital-talent engine, a focused team dedicated to managing the entire employee experience, from hiring and onboarding to creating new career paths and continuously building skills.

The key activities of this more holistic approach to talent can be broken down into three areas.

- **Workforce.** Develop a clear and surgical understanding of your talent gaps, a practical plan to fill them, and a hiring approach centered on candidate experience.
- **Work model.** Put in place a work model that enables small teams of engineers to work on the most interesting problems unfettered by layers of management.
- **Workplace.** Create a work environment that nurtures talent through diversity and a supportive culture, which is especially important within the context of hybrid and remote models. This environment includes providing different career paths that help talent develop their most valued asset: their skills.

WORKFORCE

Close your talent gap—it's wider than you think

The most effective talent strategies are grounded in a clear view of what capabilities the business needs to generate value compared with those it already has, especially in the area of cloud talent. While 58% of organizations analyze their skill gaps, our experience shows that companies typically underestimate their size. That is often because companies' talent analysis stops at the role level rather than probing what skills their people actually have.

Workforce planning also needs to happen much more frequently than the typical once or twice a year to keep pace with changing demands and shifts in the makeup of the organization.

Think candidate experiences, not recruiting process

To improve recruiting, HR departments and hiring managers tend to focus on improving their recruiting processes and introducing efficiencies. A more effective approach is to "think like a recruit" and focus on the candidate experience. That includes improving the virtual candidate experience because 70% of companies in a recent survey said their recruiting and onboarding was at least half virtual. Ways of doing that include the following.

- Tech talent wants to meet other technologists, so make sure that engineers and other relevant roles are part of your interview team. Bring your best people to interviews, online events, and conferences.
- Good candidates are ambitious and have many options. Develop an interview and evaluation approach that can lead to a decision in as little as one day. Before candidates even come through the door, assess their skills with tools such as HackerRank.
- Post and pray is not a strategy. Tech talent is not just going to job sites, so be active in nontraditional channels, such as hackathons, open-source channels, and specific curated sites for different skills. For some companies, GitHub is their best recruiting channel.
- Top talent is eager to get going, so when new hires show up to start work, make sure there is an onboarding point of contact to help them navigate the company. The onboarding process should be streamlined so that, by the end of week one, developers are able to commit code.

Top talent is interviewing you, not the other way around

Why would tech rock stars want to work for you? While money is important, top candidates care about working with newer technologies, building up their skills, being part of a culture that values technology, connecting with a purpose they find meaningful, and, most importantly, working on interesting and inspiring problems.

You can't hire or outsource your way out of your talent problems

The problem with relying on hiring is that often there is a significant lag time before someone becomes productive as well as there being a general shortfall of qualified talent. Similarly, core capabilities need to remain in house to enable the business to move quickly, so outsourcing cannot be the main answer either. The reality is that much of the talent you need will have to come from within the organization. Your workforce planning should identify the appropriate balance between building skills internally, hiring externally, and outsourcing. To build up skills internally, top companies move past traditional and subscale programs to make training both continuous (through ongoing learning journeys) and tailored (with learning programs created for specific roles and job families.

WORK MODEL

Build small, empowered teams with a clear mission, and let them execute

An expert developer is more than 10 times more productive than a novice. But many of these top engineers cannot work in traditional organizations where a surfeit of managers and bureaucratic process-

es inhibit them from doing good work at pace. In many organizations, the ratio of engineers to management and coordination and support people is 30:70; that needs to be flipped.

Tech leaders reshape their IT organizations around small squads to create highly motivated, self-managing, agile teams. Instead of managing the team day to day or simply telling them what to do, successful leaders focus on clearing organizational roadblocks, enabling team-level decision making, and setting vision and direction.

Eliminate meaningless toil and bad practices—top talent won't put up with it

You cannot hire virtuoso jazz pianists and have them just practice scales all day. In the same way, top tech talent needs a work environment where they can fully practice their craft. Leading organizations focus on eliminating as many barriers as possible for their top coders. They invest, for example, in developing high-quality, reusable code and provide world-class planning and development tools to make engineers' work lives easier. They strive to make more than 80% of testing automated and continuous—with development done only after test cases are written.

WORKPLACE

Focus on developer happiness, and productivity and performance will follow

Retaining top talent requires an environment where developers are treated like innovators, not code writers, and are active participants in the business. McKinsey's Organizational Health Index research, however, has shown that IT functions overall score well below the average in terms of organizational "health" (the ability to align around and execute strategic goals).

Business leaders can reverse this situation by making the quality of the developer experience a primary metric of success and using data to closely track job satisfaction.

Growth is also essential in building an engineering culture, and it can take many forms. Top engineers do not want to just bang out features; they want to experiment with new code, become better developers, and follow passion projects, such as reducing tech debt or optimizing systems.

Stop turning great engineers into bad managers

Do not expect your engineers to aspire to become people managers. More than two-thirds of developers, in fact, don't want to. These experts instead prefer to keep their craft sharp and pursue ever more sophisticated digital challenges.

For this reason, digital organizations often have both managerial and nonmanagerial career paths for tech talent. Leading companies use lateral career moves to promote career growth and exciting career options.

Diversity, equity, and inclusion (DEI) are strategic necessities, not special initiatives

Gender-diverse companies are 25% more likely to financially outperform less diverse companies, while ethnically diverse companies are 36% more likely to do so. By the same token, technology talent expects a diverse work environment. We have found, in fact, that prized digital talent will often refuse a job offer or even refuse to apply to companies it perceives as noninclusive. One-third of recruiters say applicants are inquiring about DEI. It is worth asking: Does your leadership team reflect sufficient diversity?

It is virtually impossible to imagine a business today succeeding without a strong base of tech talent. Only by accepting that overriding reality and making an all-out push to acquire the right tech talent can companies expect to capture the value that digital promises.

Sven Blumberg is a senior partner in McKinsey's Istanbul (Türkiye) office, Ranja Reda Kouba is an associate partner in the Vienna (Italy) office, Suman Thareja is a partner in the New Jersey office, and Anna Wiesinger is a partner in the Düsseldorf (Germany) office.

FEMTOSECOND LASER BURSTS DRILL CRACK-FREE HOLES IN GLASS

By Lisa McDonald

Femtosecond lasers have led to great advances in micromachining capabilities.

Recently, a modification of femtosecond micromachining called "burst mode" is attracting much attention. Rather than releasing single pulses at a fixed repetition rate, burst-mode lasers will emit bursts (or groups) of pulses at a fixed repetition rate. Compared to single pulses, the energy of each individual pulse within a burst is smaller. Thus, the peak fluence of each pulse (i.e., energy delivered per unit) can be nearer the optimum value, thereby increasing the removal rate.

So far, most burst-mode laser studies have involved metals and silicon. However, in April and December 2022, researchers from the University of Bordeaux and laser equipment supplier Amplitude Systems (Pessac, France) published two open-access papers exploring the use of femtosecond laser GHz-bursts to conduct top-down percussion drilling in glass.

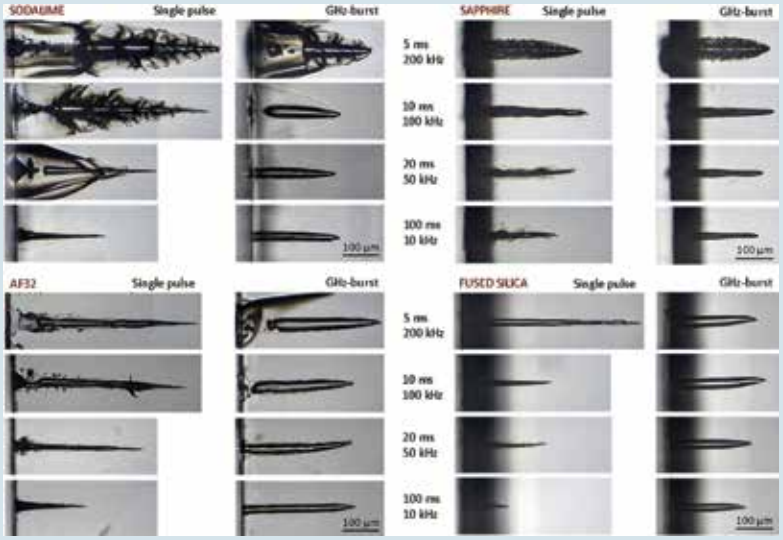


Figure 1. Microscope images of drilled holes for four different repetition rates (10 kHz, 50 kHz, 100 kHz, and 200 kHz) in four different materials (sodalime, sapphire, alkali-free alumina-borosilicate [AF32], and fused silica). The images on the left side correspond to single pulse drilling and on the right side to GHz-burst drilling with 50 pulses at an intraburst repetition rate of 1 GHz. The drilling time corresponds to 1,000 single pulses (fluence of 289 J/cm^2 per pulse) or 1,000 GHz-bursts (fluence of 300 J/cm^2 per burst), respectively. *Credit: Lopez et al.,* Optics Express *(CC BY 4.0)*

In the first paper, the researchers investigated the interaction dynamics of a GHz-burst mode femtosecond laser beam with different types of glasses during the drilling process (Figure 1). They found that single-pulse and GHz-burst percussion drilling removed material in fundamentally different ways, leading to substantially different hole morphologies. In single-pulse drilling, matter was continuously ejected, leading to conical holes with a rough internal surface. In contrast, GHz-burst mode ejected matter in a discontinuous way, resulting in quasi-cylindrical holes with a smooth internal surface.

In the second paper, the researchers further explored using a GHz-burst femtosecond laser to perform top-down percussion drilling in sodalime and fused silica glass. Analysis of the drilling process in sodalime and fused silica glass revealed three stages in hole formation.

1. **The first stage** corresponds to surface ablation. The ablation plume can expand freely in the ambient air above the target, and the drilling rate is high.
2. **The second stage** corresponds to deep ablation. The ablation plume is confined by the inner walls, leading to a decrease in ablation efficiency and a lower drilling rate (0.70 µm/burst for surface ablation versus 0.15 µm/burst for deep ablation).
3. In **the third stage**, the drilling process is over as the fluence value at the hole bottom is below the ablation threshold.

Similarly to hole length, the burst fluence and number of bursts influenced the size of the hole's diameter. When drilling begins, the diameter increases rapidly with increasing burst number. Later, it reaches a saturation value that increases with the burst fluence.

Interestingly, the effect of fluence on inner hole surface quality differed for sodalime and fused silica glass. While increasing fluence decreased the quality of the sodalime's inner hole surface, neither fluence nor burst number affected the quality of the fused silica's inner hole surface.

This difference in fluence's effect on surface quality helped explain why the researchers measured similar hole lengths in sodalime and fused silica glass even though fused silica has a higher ablation threshold, as explained below.

"The difference of the inner surface quality induces different scattering losses of the beam during the drilling process in these two materials," the researchers write. "The glossy surface of fused silica allows for low-loss reflections and therefore a more efficient beam transmission towards the tip of the hole increasing its depth. This results in a compensation for the larger energy amount needed for drilling due to the higher ablation threshold of this material. This is the reason why we measure similar lengths in sodalime and in fused silica."

Based on this knowledge, the researchers optimized the drilling conditions and reached aspect ratios up to 37 in sodalime and 73 in fused silica.

"These impressive results of percussion drilling in femtosecond laser GHz-burst mode allowing for extreme hole geometries may pave the way for future applications in photonics devices or microelectronics," they conclude.

The first open-access paper, published in *Optics Express*, is "Percussion drilling in glasses and process dynamics with femtosecond laser GHz-bursts" (DOI: 10.1364/OE.455553).

The second open-access paper, published in *International Journal of Extreme Manufacturing*, is "Crack-free high-aspect ratio holes in glasses by top-down percussion drilling with infrared femtosecond laser GHz-bursts" (DOI: 10.1088/2631-7990/acaa14).

ADVERTISERS INDEX

APRIL 2023 • VOLUME 4 • ISSUE 1

ADVERTISERS

VOLUME 4

Ceramic & Glass MANUFACTURING

Issue	Theme
April 2023	Managing the Great Resignation, Baby Boomer retirements, and other labor
June/July 2023	Energy costs and other sources of manufacturer insomnia
September 2023	CMCs—Is the future here yet?
December 2023	Furnaces, dryers, and thermal processing equipment

Alfred University
Outside of Ordinary

NEXT GENERATION GLASS RESEARCH
for Sustainable Manufacturing

Thanks to a $4.2 million grant through the New York State Department of Environmental Conservation focused on glass recycling and de-carbonization of the glass manufacturing process, Alfred University is excited to announce the launch of the Center for Glass Innovation (CGI).

The CGI is an industry-led research center, with member directed programming and access to:

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- Intellectual Property

For membership information visit:
www.alfred.edu/CACT

or Contact Dr. John Simmins at:
simmins@alfred.edu

CENTER FOR GLASS INNOVATION

Together creating the future of glass.