

Supply-chain issues compound research slowdowns

Researchers make do with alternative sources, methods, materials, and activities.

“Everyone is screaming about acetone,” says Charlie Veith, chair of vendor relations for NSF’s National Nanotechnology Coordinated Infrastructure. Acetone, which researchers use for lithography, among other things, is one of countless items that have become hard to obtain since the pandemic began. When two East Coast university nanotechnology labs were on the verge of closing last fall for lack of acetone, says Veith, he stepped in to help. He has rustled up chemicals, personal protective equipment, fused silica wafers, and more for laboratory use.

The supply chain includes sourcing, processing, controlling quality, cleaning, packaging, and shipping. “When everything along that chain is JIT [just in time], any problem screws the whole chain up,” Veith says.

Supply shortages during the COVID-19 pandemic hit researchers just as they do members of the public. “I don’t know if people are hoarding electronic components like they hoard toilet paper,” says a spokesperson for a European company that makes laboratory instruments. Orders picked up in the second half of 2021, and her company has struggled with obtaining electronics and raw materials. “Everyone has the same problem, but companies don’t want to admit it,” she says, explaining her request for anonymity. “We are busting our guts trying to be on time, but we are limping along because we can’t get components for our products.”

Delayed deliveries, extended lead times, and ever-changing quotes for consumable and durable equipment are the main ways researchers feel the effects of global supply-chain issues: Their research is hampered and they are forced to adjust priorities. “People work hard to



NASIR BASIT

AN OVERSIZED COVERALL is Ying Jia’s only choice at Northwestern University’s Micro/Nano Fabrication Facility, where she works. Since the pandemic began, facility managers have had to scramble to find clean-room supplies.

find work-arounds,” says Douglas Natelson, chair of physics and astronomy at Rice University. “But the supply difficulties enhance everyone’s stress levels. I worry most about the people who are just starting out.”

Kludge, share, innovate, pay

Nitrile gloves for clean environments, face masks, coveralls, hairnets, booties, and the like have been scarce off and on during the pandemic, at least partly because of demand for such items for medical use. Shortages of such supplies haven’t led to shutdowns at Northwestern University’s Micro/Nano Fabrication Facility, says Nasir Basit, director of operations. “But we have had panics.” He

now spends a lot of time checking with different vendors. “We will buy basically whatever we find,” he says. And Stanford University’s Mineral and Microchemical Analysis Facility has taken to reserving the best gloves for areas “where contamination could have a serious impact on research” and reusing them for “dirtier tasks,” says geochemist Dale Burns, the lab manager.

Guido Pagano started on the tenure track in physics at Rice in early 2020. He investigates quantum information processing by manipulating trapped ions and atoms with lasers. He lost more than two months in setting up his lab when the campus was closed during lockdown. But what came next was worse, he says.



PANDEMIC-RELATED DELAYS in obtaining steel held up work by four months on an upgrade at the Laser Interferometer Gravitational-Wave Observatory's site in Hanford, Washington. The new 300-meter-long building will house a narrowband optical cavity to improve LIGO's sensitivity.

"The economy restarted, and the supply-chain problems started killing me."

Pagano ordered a high-power UV pulsed laser in October 2021. The wait for the \$100 000-plus laser was given as 10 or 11 months rather than the usual 3 or 4 months. "I need this particular laser for realizing quantum gates. Without it, I can't do any coherent operations on qubits," he says. He's trying to borrow a laser from other research groups.

And in March 2021, Pagano ordered a custom aluminum board on which to mount optics. He wants screw holes that are closer than the standard one-inch separation. Normally, he says, such an item would take about six weeks. A board was produced but lost by the shipper in September, and he was still waiting in December. The company attributed the delays to aluminum being unavailable and to staff shortages. In the meantime, Pagano has kludged a temporary solution.

"In some cases, we have to spend extra

money to buy more sophisticated products than we need," says Jaime Cardenas, who is on the tenure track at the University of Rochester. His research focuses on integrated photonic devices for applications in communications, sensing, and quantum information. Among the materials he buys is graphene fixed to copper tape. "It's standard and inexpensive," he says. "But the last time we tried to order it, the vendor was having trouble obtaining copper." So he bought what he could get: graphene on a dissolvable polymer tape that cost 30% more. Concerned that supplies would continue to be tight, he bought extra.

And when his usual vendor couldn't supply fused silica wafers, Cardenas found a new source—and paid 50% more. Another example of fallout from global supply-chain issues occurred when he and colleagues ordered a dicing saw from Japan. With shipping containers backed up offshore, he says, "shipping

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ISSUES & EVENTS

by sea wouldn't make the deadline before the funding 'vanished.' We had to fly a big piece of equipment by air. It tripled the shipping cost."

Matthew Yankowitz joined the University of Washington as an assistant professor of physics in August 2019. He studies layered two-dimensional quantum materials with emergent magnetic, superconducting, and topological properties. A dilution refrigerator for a shared facility arrived before the pandemic—and then gathered dust for months until technicians from the Finnish supplier could enter the US and assemble it. A cryostat he ordered from Tennessee and a scanning tunneling microscope from Germany arrived months late.

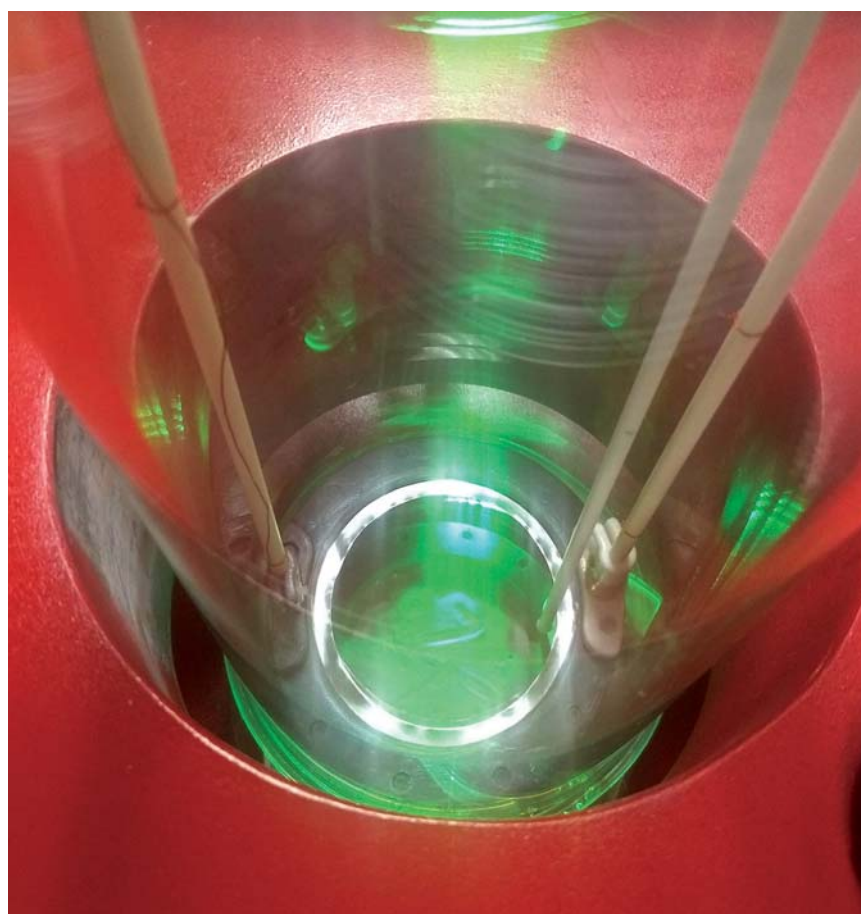
Obtaining consumables can also be problematic, says Yankowitz. "You don't know what will be available until you order, and lead times can be shockingly long." An example is the package mount

that creates an electrical connection between a sample and the wires on a probe. In the past they were "ready to ship immediately," he says. Now the quoted time for delivery is five months. "I doubt anyone can realistically project that far out."

"If we got desperate, we would remove devices we had measured previously and reuse the package mounts," Yankowitz says. "We'd have to make difficult decisions about which working devices we should dismount."

Small peanuts and long drives

Carlos Romero-Talamás of the University of Maryland, Baltimore County, is overseeing the construction of two plasma devices. For a centrifugal magnetic mirror, a fusion reactor candidate, the delivery times for a 6-meter-long aluminum chamber and a vacuum pump are delaying the work schedule by at least three months. The other device, a 7-tesla



CARLOS A. ROMERO-TALAMÁS

FINDING A VENDOR to customize parts for their planned high-magnetic-field (7 tesla) studies has been difficult for Carlos Romero-Talamás and his group at the University of Maryland, Baltimore County, so for now they have intensified their investigations of dusty plasmas at low magnetic fields (0.08–0.12 tesla).

pulsed Bitter magnet for investigating dusty plasmas, needs metal plates with holes for cooling. Romero-Talamás has the metal, but he hasn't been able to find a company to make a die to punch the holes. "I've contacted at least a dozen vendors," he says. "The ones that reply don't want the business. It will be less than \$100 000, and that seems to be small peanuts for them."

With the dusty plasma project stalled, Romero-Talamás says that for now his group is focusing on experiments at around 0.1 tesla and "making the most of the tools we have at hand." Still, he says, "I'm worried about students not finishing on time."

At the University of Pennsylvania, Daeyeon Lee's group in the chemical and biomolecular engineering department uses microfluidic devices to synthesize materials for biomedical applications. One of their projects involves encapsulating mRNA into lipid nanoparticles for vaccines. Starting last summer, they couldn't get the polydimethylsiloxane they need to make the devices. "PDMS is a common, cheap elastomer," says Lee. "You normally never think about running out of it. This [shortage] stops many people's research."

His students identified and bought similar elastomers, tested them, and created new protocols to make stopgap microfluidic devices, says Lee. The devices do the job, he says, but the material is not as well characterized as PDMS. "Is the behavior impacted by the new material? When we try to publish, there will be questions."

Lee's group encountered another supply-chain issue when a bonder in the local clean room broke down. Bonding is the last step in fabricating silicon-and-glass microfluidic devices. "The vendor came and diagnosed the problem," says Lee, "but couldn't get the parts to fix the instrument." For now, a postdoc and a student pack up partly fabricated devices and drive about 320 kilometers to complete the process at a facility at the Pennsylvania State University. That work-around risks contaminating the devices, costs more, and takes longer. "What should take an hour takes a week," Lee says.

"A strategic game"

Some companies say the pandemic hasn't affected their business or ability to de-

liver products on time. "We have things under control, we have planned ahead, and our customers don't feel drawbacks," says Stephan Koch, vice president of sales with the test and measurement manufacturer Zurich Instruments. And at least for some software companies, the pandemic has been a boon: "We have seen corporations spending more time with design software," says Chris Maloney, managing director of US operations and director of business development for VPIphotonics, a design automation company. "They test their design before purchasing something. It's become more important because it's hard to get components."

Still, many tech companies are seeing a surge in orders. And even if the companies don't want to admit difficulties, it's clear from what their customers say that delays and scarcities are common.

Diane Blake is director of strategic sourcing at Lake Shore Cryotronics, an Ohio-based company that makes temperature and magnetic field monitoring instruments and materials characterization products. "For us," she says, "the supply problems started last year with the freeze in Texas," where the company's main source of epoxy for sensors is located. Add to that delays in the delivery of analog-to-digital converters after a fire at a Japanese company in March 2021 and microchips being held up because of water shortages in Taiwan and COVID-related workforce reductions in Malaysia. "We have so many single-source critical components," says Blake.

The company's longtime supplier of alumina probe blades shut down when the owner contracted COVID-19, Blake says. "These parts go into systems that could cost \$200 000. This was urgent." Additionally, the company previously machined parts from aluminum tubes, but recently it has only been able to get solid rods, which makes fabrication more time consuming and expensive. And for electronics components for her company's products, lead times used to be 8–10 weeks. Now, she says, it's increased to 52 weeks. "Arrival times have been pushed into early 2023."

"We are looking at alternative parts," Blake says. "And we will have to review what instruments to concentrate on for 2022. It's a strategic game we are playing."

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