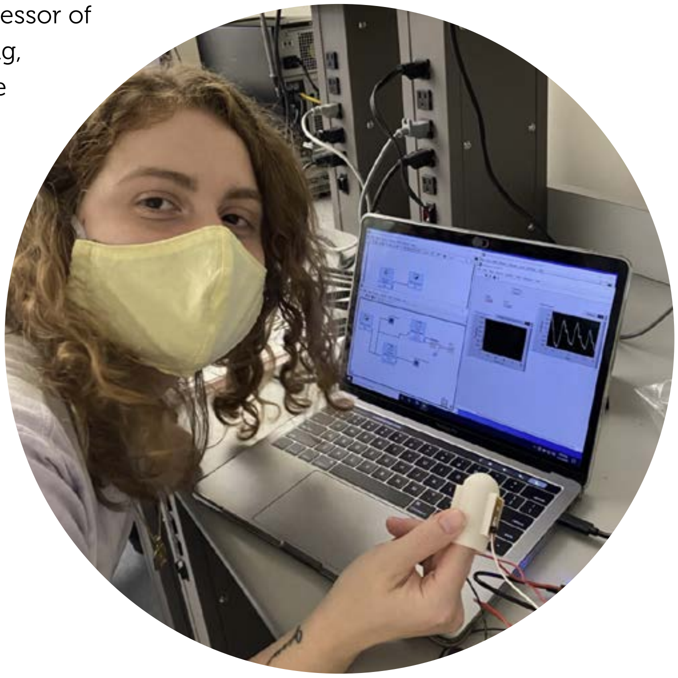
faculty news

Designing classes for the COVID era

The move to virtual classes over the past year tapped into the creativity of engineering professors as well as students. Leon Bellan, associate professor of mechanical engineering, had students construct musical instruments from household objects. Virtual lectures on string resonance, pipe resonance and other acoustics phenomena then tied basic physics to musical instruments. Next, students tuned the instruments and predicted their pitch based on physics.

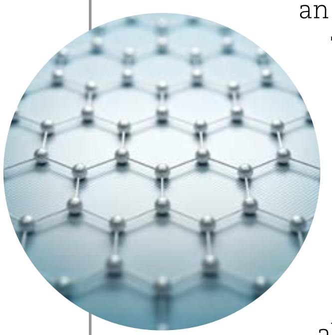
Romina Del Bosque, assistant professor of the practice of biomedical engineering, created a new instrumentation course and its lab, which was mostly taught remotely. She made kits for each student containing electronic components and instruments so they could get independent, hands-on experience.



Bellan and Del Bosque are among five faculty who received new awards for innovative teaching. Dan Arena, associate professor of the practice of computer science; Tyler Derr, assistant professor of computer science; and Kevin Galloway, research assistant professor of mechanical engineering, also received awards.

Scaling production of graphene membranes

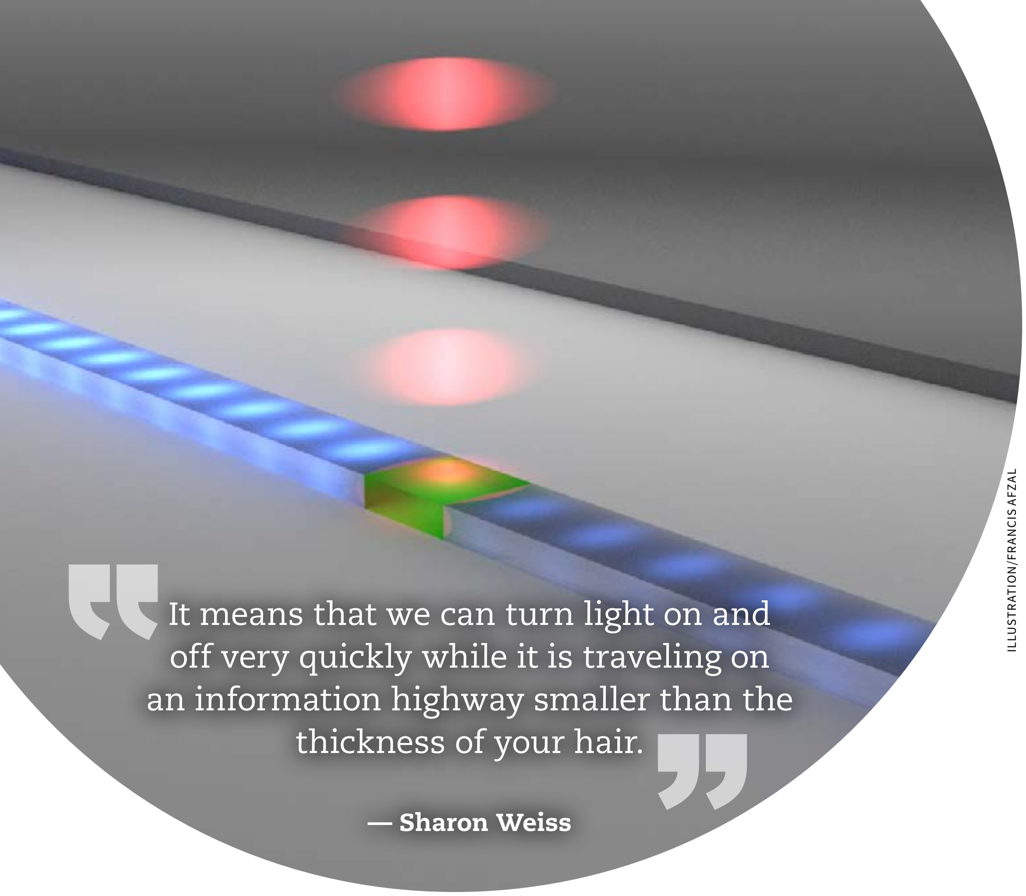
Graphene is a marvelous material, but can it be manufactured?



Vanderbilt engineers have demonstrated how, by combining a drop of rubbing alcohol, an office laminator and ingenuity. The hot lamination process enables a clean transfer of graphene to polycarbonate supports with 99.2 percent coverage—while preserving porosity.

The work is an important step toward making atomically thin graphene membranes scalable and practical for manufacturing, said Piran R. Kidambi, assistant professor of chemical and biomolecular engineering. The experiment produced membranes that outperformed state-of-the-art commercial dialysis membranes.

Graphene membranes present potential for breakthrough advances in separation of a variety of microscopic ions and molecules, including salts, proteins or nanoparticles, and are relevant to industrial applications for water desalination and gas separations. Such membranes also are useful for chemical, biological and medical research and the purification of substances used in pharmaceuticals.



ILLUSTRATION/FRANCIS AFZAL

Computing faster than one-trillionth of a second

A Vanderbilt team is the first to demonstrate that it may be possible to achieve data transmission rates exceeding one terabit per second on a single channel.

"It means that we can turn light on and off very quickly while it is traveling on an information highway smaller than the thickness of your hair that is made of the same material inside computers and cellphones," said Sharon Weiss, Cornelius Vanderbilt Chair and professor of electrical engineering, physics, and materials science and engineering.

The technology unjams bottlenecks in data streams using a hybrid silicon-vanadium dioxide waveguide that can turn light on and off in less than a picosecond, or one trillionth of a second. When another light pulse struck the vanadium dioxide, injected light pulses selectively turned off. The material properties of vanadium dioxide and the time duration in which the two laser pulses interact in the vanadium dioxide make possible the remarkable speed with which the light pulses were turned off and then came back on.

"We can turn light on and off faster than anyone else using this information highway, which means that future computers may be able to run a lot faster, and also with less power than current computers, by using light," said longtime collaborator Richard Haglund, Stevenson Professor of Physics.

Optimizing the size, shape and volume of the vanadium dioxide component and investigating alternate waveguide configurations are the next steps, researchers said.

Heart attack treatment in development to speed healing

Researchers have shown that early inhibition of a protein receptor in specialized heart cells speeds healing after a heart attack. The discovery has significant implications for survival, with a promising drug under development.

The team, led by David Merryman, a professor of biomedical engineering who holds the Walters Family Chair, found blocking serotonin 2B after a heart attack results in a functional scar that is less likely to expand beyond the initial wound to put additional pressure on the heart.

Typically, only a small region of the heart dies during a heart attack, but over time the borders of the scarred region expand. The resulting stress on the heart to do more with less induces heart failure. The researchers set out to precisely determine what the protein receptor did during heart attacks and how it might be altered for improved outcomes.

In collaboration with the Warren Center for Neuroscience Drug Discovery, Merryman is developing a highly targeted molecule that impacts only serotonin 2B in the cardiopulmonary system where the receptor is highly prevalent.

"This molecule has the possibility to not only treat myocardial infarction, but also high blood pressure in the lungs known as pulmonary arterial hypertension," Merryman said. "We are working with many clinicians to sort out the best path for drug development that we think has significant implications for human health."