A team of scientists at Yale University, New Haven, Conn., formulated bulk metallic glasses (BMGs) that have a random atomic structure and can be softened and shaped at low temperatures allowing it to be blow molded much like how plastics are formed. BMGs are a combination of materials including zirconium, nickel, copper, and titanium, which can be molded in seconds, are less expensive and faster than traditional metal processing, and have much greater strength and durability than plastic. www.yale.edu.

A team of scientists at Penn State, State College, developed the first optical fiber made with a core of zinc selenide—a light-yellow compound that can be used as a semiconductor. The new class of fiber provides more versatility not just in the visible spectrum, but also in the infrared—electromagnetic radiation with wavelengths longer than those of visible light. It promises to open the door to more versatile laser-radar technology. www.psu.edu.

Silver-diamond composite cools electronics

Researchers at the Georgia Tech Research Institute (GTRI), Atlanta, are developing a solid composite material to help cool small, powerful microelectronics used in defense systems. The research is focused on producing a silver-diamond thermal shim of unprecedented thinness (250 μm or less). The ratio of silver to diamond in the material can be tailored to allow the shim to be bonded with low thermal-expansion stress to the high-power wide-bandgap semiconductors planned for next generation phased-array radars.

Diamond has a very low coefficient of thermal expansion of about 2 ppm/K. But the materials used to make wide-bandgap semiconductors, such as silicon carbide or gallium nitride, have higher CTEs, generally in the range of 3-5 ppm/K. By adding just the right percentage of silver (CTE of about 20 ppm/K), the silver-diamond composite can be tailored to expand at the same rate as the semiconductor material. By matching thermal-expansion rates during heating and cooling, the researchers enabled the two materials to maintain a strong bond. www.gtri.gatech.edu.

Engineering atomic interfaces for new electronics

Led by University of Wisconsin-Madison Materials Science and Engineering Professor Chang-Beom Eom, a multi-institutional research team discovered how to manipulate electron oxide interfaces by inserting a single layer of atoms. They used two pieces of precisely grown strontium titanate. Between the pieces, the researchers inserted a one-atom-thick layer of one of five rare-earth elements, and found that the rare-earth element layer creates an electron gas with some interesting characteristics. The gas behaves more like an electron “liquid,” since the electrons move more in tandem, or in correlation, than a gas normally does.

The electron layer displays distinct characteristics depending on the particular rare-earth element used. Materials with larger ionic radii, such as lanthanum, neodymium, and praseodymium, are conducting, whereas materials with smaller radii, including samarium and yttrium, are insulating. The discovery of liquid-like behavior in the electron layer could open up an entire field of interfacial engineering, as well as new applications that take advantage of electron interactions. This work could be expanded to create not only conductive or insulating interfaces, but also magnetic or optical ones. www.wisc.edu.

A robot named WANDA

Lawrence Berkeley National Lab, (Calif.) scientists along with The Molecular Foundry established a revolutionary nanocrystal-making robot, capable of producing nanocrystals with high precision. This one-of-a-kind robot, called WANDA (Workstation for Automated Nanomaterial Discovery and Analysis), provides colloidal nanocrystals with custom-made properties for electronics, biological labeling, and luminescent devices. WANDA’s synthetic prowess can help researchers sift through a large, diverse pool of materials for specific applications. Such a combinatorial approach has been used for decades in the pharmaceutical industry and now is being applied to nanomaterials at the Foundry.

WANDA’s liquid-handling robotics prepare and initiate reactions by injecting nanocrystal precursor chemicals into an array of reactors. After a series of reactions is complete, the structural and optical properties of these nanocrystals can be screened rapidly, also using automated methods. WANDA is housed inside a nitrogen-filled chamber, designed to keep oxygen and water from interacting with reactive precursor chemicals and freshly formed nanocrystals. Since this robot is controlled by software protocols, novice users can direct WANDA to perform complex workflows that traditionally require extensive chemistry experience. www.foundry.lbl.gov; www.lbl.gov.