conductance to an additional DNA molecule forming a junction. They said, however, that conductance steps do not always have the same values, which reflect microscopic differences in the DNA–electrode contacts. The researchers therefore took more than 500 measurements and constructed a conductance histogram in which they found peaks that occur at multiples of $1.3 \times 10^{-3} G_0$. Conductance histograms of other DNA duplexes also displayed peaks, but at multiples of different values. For $(GC)_n$, the researchers found that the conductance is a linear function of reciprocal DNA duplex length, measured in base pairs. The conductance of the $CGCG(AT)_mCGCG$ duplexes does not decrease nearly as slowly with length as the conductance of the (GC) duplexes and can be fit by a function of the form $\mathbf{A}\exp(-\beta L)$, where $\mathbf{A}$ ($1.3 \times 10^{-3} G_0$) and β (0.43 ± 0.01 Å) are constants and L is the length of the AT segment.

The researchers said that their findings are consistent with previously published models that describe charge transport in DNA as a tunneling-like process for short DNA and a hopping-like process for relatively long DNA duplexes.

Tao said, "The sensitive dependence of the conductance on the DNA sequence suggests the possibility of reading the chemical information of DNA via direct conductance measurement."

STEVEN TROHALAKI

Diatom Frustules Serve as Scaffolds for 3D Polymeric Structures with Nanoscale Features

Shape-tailored microscale polymeric structures with feature sizes down to the nanoscale are becoming increasingly important for various applications, such as in microelectromechanical systems. Current techniques, such as lithographic-based layer-by-layer fabrication, are not well suited for the production of three-dimensional polymeric structures with complex shapes. In addition, large numbers of polymeric structures with a specific shape need to be created. C. Gaddis and K. Sandhage of the Georgia Institute of Technology have now demonstrated a technique that uses diatoms—single-celled algae—as scaffolds to form free-standing microscale polymeric structures. Diatoms have amorphous silica nanoparticle-based rigid cell walls (frustules). In this study, a thin (submicron) polymeric coating was applied to diatom frustules. The underlying silica frustules were then dissolved, leaving behind the polymer with the shape and features of the diatoms.

Diatom frustules come in a wide range of shapes with nanoscale features. They can be precisely replicated in a massively parallel manner with ease. The frustules used in this study, as reported in the *Journal of Materials Research* (Web release date of accepted preprint, July 1) had hollow cylindrical shapes with diameters of 8–12 μm and mesoscale pores with diameters of several hundred nanometers in rows along the cylinder length. After being cleaned, the diatom frustules were dipped in a coating solution containing a two-part, 5-min-curing epoxy mixture dissolved in acetone. After evaporation of the acetone, the epoxy was allowed to cure. The concentration of the epoxy in the solution was adjusted to obtain a coating that preserved the pores and fine features of the diatom frustules. The coated frustules were then dipped in hydrofluoric acid to dissolve the silica diatom shells, leaving behind the polymer coatings in the shape of the diatoms (see Figure 1). Gaddis and Sandhage found the polymer structures to be very similar in morphology to the starting diatom frustules.

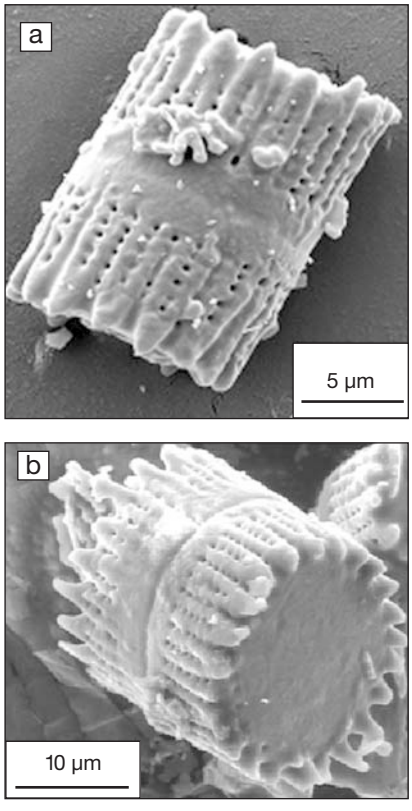

Figure 1. (a) Secondary electron image of a silica-based diatom frustule used as a transient scaffold; (b) secondary electron image of an epoxy structure derived from a diatom frustule scaffold. Reproduced with permission from the Journal of Materials Research.

In addition to diatom species, other self-replicating biomineralized micro- and nanostructures (such as microshells and sponges) can be used to yield various 3D polymeric shapes with desired morphologies. The technique is not limited to naturally available diatoms or biomineralizing organisms. According to the researchers, genetic engineering could be used in the future to produce replicable bioscaffolds with non-natural shapes. The polymeric coatings are not confined to epoxy-based compositions. Other polymer structures can be produced, so long as a dilute coatable solution can be formed and the underlying scaffold can be removed, leaving the polymer structure intact without being affected by the selective dissolution treatment. Upon scaleup, the researchers said, the current process can be used to produce large quantities of inexpensive three-dimensional polymer micro/nanoscale structures for use in various biomedical, chemical, catalytic, photonic, aerospace, and other applications.

GOPAL RAO

C_{60}-Based Organic Diode Performance More than 100× Better than Other Organic Semiconductor Devices

In recent years, organic semiconductor devices (OSDs) have found increasing practical applications in displays, transistors, lasers, memory, and diodes. So far, however, their performance has lagged far behind their inorganic counterparts, particularly with respect to response speed and current density. L.P. Ma, J.Y. Ouyang, and Y. Yang of the University of California, Los Angeles, have achieved a more than 100-fold improvement in response speed and current density, compared with common OSDs, with their C_{60}-based organic diode, formed with one ohmic contact and one rectifying contact. As reported in the June 7 issue of *Applied Physics Letters* (p. 4786), the researchers used a C_{60} electron acceptor layer sandwiched between a Cu cathode and an Al anode; they heat-treated the device for 5 min at 120°C to achieve the huge leap in performance.

The scientists fabricated the organic diodes by first depositing Cu using thermal vacuum deposition onto a smooth glass substrate followed by C_{60} (100 nm thick) and Al, creating a 0.0625 mm^2 device. Only after the heat treatment did the scientists measure injection current densities of 363 A/cm^2 at 2.4 V and 1 MHz current responses. Previous attempts to