TECHNOLOGY

Buckyballs store 1s and 0s in new memory device

In pursuit of faster and denser memory chips that might one day enable computers to boot instantly, scientists have created a material that stores bits of data in the soccer ball–shaped carbon molecules known as buckyballs.

Research groups around the world have made great strides in devising molecule-based electronic devices. But organizing such devices in vast numbers has proved difficult. Alternatively, some scientists have focused on making chips out of polymers and other organic materials, a much easier task. However, "organic electronics tend to be slow," says Alokik Kanwal of Rutgers University in Piscataway, N.J.

Kanwal and his colleagues decided to combine buckyballs and polymers, hoping to end up with a new electronic material that combines the best that each ingredient has to offer.

The researchers sandwiched a mix of the two ingredients between two sets of aluminum tracks, which served as electrical contacts. Applying a voltage to the material caused the buckyballs to switch between two electronic states, each of which represents a 1 or a 0. The molecules retained the information until the researchers applied an opposite voltage. This erased the data by switching the buckyballs back to their original state.

The materials achieved switching speeds between 10 and 30 nanoseconds, which are in the ballpark for a useful memory chip, Kanwal says. What's more, the buckyball-polymer memory consumed little power and could store data for at least 24 hours. These combined traits make the material a good candidate for future memory devices, says Kanwal. —A.G.

TISSUE ENGINEERING

Bonelike polymer supports stem cells

Growing stem cells on polymer scaffolds could be an effective strategy for manufacturing replacement tissues—a piece of bone to repair a defect or a fracture, for instance (*SN: 3/6/04, p. 155*). However, keeping the cells alive on the scaffold long enough to differentiate into specific cell types and to form new tissue remains a challenge.

A group of biomedical engineers led by Kristi Anseth of the University of Colorado at Boulder now has taken on the challenge by designing a polymer scaffold that mimics the environment in which natural bone grows. The scaffold provides stem cells with the right molecular cues for becoming bone tissue.

In previous experiments, the researchers mixed stem cells derived from a person's bone marrow and encapsulated them within a polymer-gel scaffolding. In order to grow, the stem cells need to attach to the polymer chains making up the scaffold, says team member Charles Nuttelman. The cells wouldn't stick to this standard gel in the team's earlier trials. So, Nuttelman and his colleagues affixed negatively charged, phosphate-containing molecules to the polymer chains. When they added positively charged calcium ions to the cells, the calcium stuck and the scaffold mineralized into bonelike material.

BUILD STRONG BONES Stem cells grown in a gel that mimics the natural environment of bones could one day repair bone fractures or defects in a skull.

PHOTODISC

The stem cells readily adhered to this structure and proliferated, a necessary step for growing tissue. Even better, 97 percent of the cells on the mineralized scaffold survived for more than a week. Only about 10 percent of such cells survive in the standard polymer gel, says Nuttelman.

In the future, doctors may extract a patient's own stem cells, mix them with the new mineralized polymer, and inject the combination into a site of injury, where the gel scaffold would help give rise to new bone. —A.G.

ART CONSERVATION

Glass materials let Venetian art shine

Sixteenth-century Venetian painters, renowned for their brilliant and colorful works of art, may have borrowed a few tricks from an unlikely source: glassmaking. Recent analyses of several Venetian paintings reveal that the artists mixed glassy particles into their oil paints, perhaps in an effort to expand their palettes and enhance the vibrancy of their colors.

"The glassmaking industry was burgeoning in Venice at the time," says Barbara Berrie, a conservation scientist at the National Gallery of Art in Washington, D.C. While scanning a 1543 inventory from a Venetian store that sold paint pigments, Berrie discovered a number of materials necessary for making glass. She then analyzed several Venetian paintings to see whether she could find similar materials.

Using scanning electron microscopy and other analytical techniques, Berrie examined a sample taken from Lorenzo Lotto's 1522 painting *St. Catherine*. She found microscopic particles of pure silica—one of the main components of glass. Analyses of Tintoretto's *Christ at the Sea of Galilee* disclosed transparent green particles with a chemical composition very similar to that of blue smalt, a cobalt-containing glass material. And in Raphael's *Alba Madonna*, Berrie found lead silicate, a yellow glass made by master glassmakers at the time.

Berry suspects that Venetian artists were attracted to the way the glassy additives made the colors in their paintings seem more luminous. —A.G.

BIOMATERIALS

Mussel glue inspires coating for medical implants

Many medical implants, such as catheters, stents, and other cardiovascular devices, fail because cells stick to them and interfere with their operation. Although researchers have tried coating these devices with antifouling polymers, the coats tend to be susceptible to enzymatic degradation and often peel off. However, a new coating inspired by the adhesive secreted by mussels could be more durable.

A group led by Phillip Messersmith of Northwestern University in Evanston, Ill., synthesized an antifouling material consisting of two linked parts. The first part is a proteinlike polymer designed to prevent cells from sticking to it. The polymer also is resistant to enzymatic degradation and doesn't elicit immune responses, says Northwestern team member Andrea Statz. Attached to this polymer is a second component, one that emulates the adhesive protein in mussel glue. In tests on titanium dioxide, a common implant material, the antifouling coating stuck fast.

Cell tests also were promising. After 20 weeks of sitting in a solution containing mouse cells, the new coating had few of the cells adhering to it. Without the coating, a titanium dioxide surface became covered with cells. —A.G.