Researchers synthesize a novel Metal Rubber™ material

Blacksburg, VA, June 29, 2004 — Engineers in the nanotechnology field have introduced a new material that has the qualities of both metal and rubber, and one that is highly electrically conductive.

The researchers have assembled this material molecule by molecule, the hallmark of nanotechnology. By building the new substance in this fashion, they were able to synthesize this elastic material with the strength of metal. More intriguing, the non-toxic material can conduct electricity, even as it is being stretched. These properties make it appealing to the microelectronics, biomedical, aeronautical and automotive industries.

Unlike "conducting polymers" that have been researched and developed for many years, these "self-assembled" nanocomposites contain mechanically flexible polymers and electrically-conducting metal nanoclusters. As with most composites, control over the percentages of both parts can be used to obtain different properties.

The new material is thick enough to be used in structural materials such as aircraft bodies. It is appropriate as a conducting, low weight, low cost material for electronics. Or, as another example, the electrodes in the METAL RUBBER™ have huge potential in the biomedical field.

Most composites must be manufactured in a very hot oven. This nanocomposite or METAL RUBBER™ can be made in a day at room temperature and the process is environmentally benign. In the electronics industry, known for its hazardous byproducts, this feature should be particularly appealing.

Cost-wise, the non-toxic materials are produced using an automated wet chemistry manufacturing process that is both low-cost and easily scalable. In quantity the produced materials are potentially inexpensive.

Richard Claus, a distinguished professor of electrical and computer engineering at Virginia Tech, and his colleague, Jennifer Hoyt Lalli, a research scientist at NanoSonic, Inc. of Blacksburg, Va., are the lead developers of the new material. Claus, the only engineer at the University to be honored by the state as one of its Outstanding Scientists, is also the director of the Fiber and Electro Optics Research Center (FEORC). This center has spun off some 20 companies since its founding in 1985, and NanoSonic is its most recent entrepreneurial effort. Claus serves as president of the company.

Self-assembly refers to material synthesis methods whereby large numbers of molecules form together to create useful components. Often the process relies on the electronic charge properties of cationic and anionic molecules that may be alternately deposited on substrates to form multi-layered substances.

Virginia Tech and NanoSonic have used this electrostatic self-assembly (ESA) method to combine noble metal, metal oxide and metal alloy nanoclusters, cage-structured molecules such as nanotubes and buckeyballs, polymers and biomolecules, to obtain thin films with a wide range of constitutive properties. Thin films can be used as protective coatings in the various materials industries.

Unfortunately, individual molecular layers are one-molecule thick (i.e. on the order of nanometers), so ESA has essentially been limited to the formation of ultra-thin films on the order of 100 nm in thickness (a thousandth the thickness of a human hair), and over several-day fabrication times.

A major challenge of the National Nanotechnology Initiative (NNI) is to develop techniques whereby nanosized chemical precursors may be formed into larger materials.

Most current nanotechnology research is concerned with the precursors, typically specialized molecules much smaller than a micron in cross-sectional dimension. The challenge to make practical products - cars, airplanes, furniture, buildings - that incorporate nanomaterials and utilize their special properties, has been difficult. It requires techniques that will assemble many, many of these nanomaterials into larger forms.

NanoSonic and Virginia Tech's success comes from their development of a "modified approach" that allows them to significantly speed up the ESA process, Developed at Virginia Tech, the process was patented and then licensed to NanoSonic.

Lalli explains that the modified ESA process allows them to create materials at a rate on the order of millimeters of thickness per hour of synthesis time. "The creation of these free-stranding materials is significant to both potential commercial scale-up, and to the production of nanomaterials that are of practical use in the macroworld," Claus adds.

Claus and Lalli have made these free-standing, mechanically robust, multi-millimeter thick films with properties determined by the constituent molecules and the order of the multi-layer deposition. NanoSonic's METAL RUBBER™ is synthesized in this way.

Potential applications of these materials include use in electrostatic materials, conducting adhesives, electromagnetic shielding, printed circuit boards, flex circuits, flexible electronics, artificial nerves, antistatic clothing, as electrodes on high strain sensors and actuators, and in aircraft structures.

Claus says, "As we self-assemble macroscopic materials, our goal is to design and implement nanostructured mechanical sensors that have important performance advantages over conventional sensors such as foil strain gages, pressure transducers or optical fiber devices.

Contact

www.nanosonic.com

540-626-6266