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Flexible electronics could find applications as sensors, artificial muscles

Flexible electronic structures with the potential to bend, expand and manipulate electronic devices are being developed by researchers at the U.S. Department of Energy's Argonne National Laboratory and the University of Illinois at Urbana-Champaign. These flexible structures could find useful applications as sensors and as electronic devices that can be integrated into artificial muscles or biological tissues.

In addition to a biomedical impact, flexible electronics are important for energy technology as flexible and accurate sensors for hydrogen.

These structures were developed from a concept created by Argonne scientist Yugang Sun and a team of researchers at the University of Illinois led by John A. Rogers. The concept focuses on forming single-crystalline semiconductor nanoribbons in stretchable geometrical configurations with emphasis on the materials and surface chemistries used in their fabrication and the mechanics of their response to applied strains.

“Flexible electronics are typically characterized by conducting plastic-based liquids that can be printed onto thin, bendable surfaces,” Sun said. “The objective of our work was to generate a concept along with subsequent technology that would allow for electronic wires and circuits to stretch like rubber bands and accordions leading to sensor-embedded covers for aircraft and robots, and even prosthetic skin for humans.

“We are presently developing stretchable electronics and sensors for smart surgical gloves and hemispherical electronic eye imagers,” he added.

The team of researchers has been successful in fabricating thin ribbons of silicon and designing them to bend, stretch and compress like an accordion without losing their ability to function. The detailed results of these findings were published in the Journal of Materials Chemistry paper, " Structural forms of single crystal semiconductor nanoribbons for high-performance stretchable electronics," which is available online at http://www.rsc.org/Publishing/Journals/JM/article.asp?doi=b614793c.

Before coming to Argonne in August of 2006, Sun worked as a research associate under John A. Rogers at the University of Illinois at Urbana-Champaign where this project was first initiated. With the opening of Argonne's Center for Nanoscale Materials late last year, he was attracted by the facility's ability to enhance scientists' investigations in the properties of materials at nanoscale dimensions.

The Center for Nanoscale Materials at Argonne integrates nanoscale research with Argonne's existing capabilities in synchrotron X-ray studies, neutron-based materials research and electron microscopy with new capabilities in nanosynthesis, nanofabrication, nanomaterials characterization, and theory and simulation.

With the many resources at Argonne at his disposal, Sun plans to expand his research to focus on applications in other biological and chemical sensors.

Funding for this research was provided by the U.S. Department of Energy's Office of Basic Energy Science.

The nation's first national laboratory, Argonne National Laboratory conducts basic and applied scientific research across a wide spectrum of disciplines, ranging from high-energy physics to climatology and biotechnology. Since 1990, Argonne has worked with more than 600 companies and numerous federal agencies and other organizations to help advance America's scientific leadership and prepare the nation for the future. Argonne is managed by UChicago Argonne, LLC for the U.S. Department of Energy's

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