Making Nanowires More Electrically Stable

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(PhysOrg.com) -- It's widely predicted that future electronics will largely depend on something really small -- nanomaterials used for building nanoelectronics. A key component of these tiny circuits is stable nanowires that work reliably for a decade or more. Currently, however, nanowires often fail after anywhere from a few days to a few months, due to prolonged electrical stressing.

Carmen Lilley, assistant professor of mechanical and industrial engineering at the University of Illinois at Chicago, is working on new procedures for making nanowires more electrically stable -- and hence more reliable. She was recently awarded a $505,532 National Science Foundation Faculty Early Career Award to help advance her project.

"My idea is to look at the physics of failure," she said. "How do these systems fail when stressed electrically? If we can develop a basic understanding of the mechanisms that control failure and a way to model these mechanisms, we can create material designs with predictable behavior."

Lilley's research focuses on studying properties of single crystals of common conductor metals such as gold, silver, copper, nickel and iron, and their unusual behavior characteristics at the nanoscale.

"At these smaller scales, the electrical resistivity of the structure changes," she said. "Single crystalline materials are of interest because we can use them to control the material uncertainties that influence typical experiments such as isolating electrical resistivity measurements

from grain boundary effects, surface contaminant and roughness effects. What is the basic electrical resistivity at different sizes within the nanoscale?"

Lilley's goal is to create a basic design scheme to build stable nanowires for any application. For future highly integrated circuits and nanoelectronics, nanowires are the "essential building block," she said. "But to be successful, they must be stable, and that's a considerable challenge."

Lilley plans to use part of her grant to continue an ongoing effort to attract underrepresented minorities to engineering careers. One effort is the launch of a graduate mentoring program called "Preparing for Academic Careers in Engineering," or PACE. This program is sponsored by Women in Science and Engineering, the UIC College of Engineering and the department of mechanical and industrial engineering.

She also hopes to give undergraduate assistants more hands-on laboratory experience, and to bring students from Chicago Public Schools to UIC to see work in the lab and view some of the breathtaking images produced by instruments such as scanning electron microscopes.

"These beautiful images often have artwork properties. For the visiting kids, it can spark an interest."

Provided by UIC