Scientists carve nanowires out of ultrananocrystalline diamond thin films

November 4 2011

A team of scientists working at Argonne National Laboratory's (ANL) Center for Nanoscale Materials has successfully carved ultrananocrystalline diamond (UNCD) thin films into nanowires, boosting the material's functionality and providing potential improvements to the fabrication of biosensors.

UNCD thin films are a special form of diamond invented at ANL, and the subject of tremendous interest because of the material's highly desirable ability to alter its electrical properties when the chemical bonding between grain boundaries is modified. "It's a highly attractive carbon-based material with a wide range of applications in communications, medicine, and defense," notes Sumant.

A primary motive behind their studies, he explains, is to understand the electrical transport properties of UNCH when it's fabricated into a nanowire geometry. They also want to see how these properties can be altered by changing chemical bonding at the grain boundary and by taking advantage of increased surface-to-volume ratio at the same time.

"We've demonstrated a pathway to fabricate UNCD nanowires, with widths as small as 30 nanometers at a thickness of 40nanometers, by using a top-down fabrication approach that combines electron beam lithography and [a] reactive ion etching process," says Sumant.

Among the exceptional electrical properties of the UNCD nanowires, the researchers also discovered a resistance that is extremely sensitive to the

adsorption of gas molecules at the grain boundaries. This discovery opens up new possibilities for the fabrication of advanced nanoscale sensors for specific use, according to the team.

The main advantage of UNCD over other materials, he explains, is that it provides stable functionalization, which could be very useful for fabricating a new breed of sensors.

UNCD nanowires are initially expected to find applications in the biosensor area, or in pressure or gas sensors, which could be used by the micro-electromechanical systems (MEMS) and semiconductor industries.

Provided by American Institute of Physics

Citation: Scientists carve nanowires out of ultrananocrystalline diamond thin films (2011, November 4) retrieved 20 September 2024 from https://phys.org/news/2011-11-scientists-nanowires-ultrananocrystalline-diamond-thin.html