Nanotubes and nanowires as biological sensors & actuators

Robert Hamers, Daniel van der Weide, and Lloyd Smith
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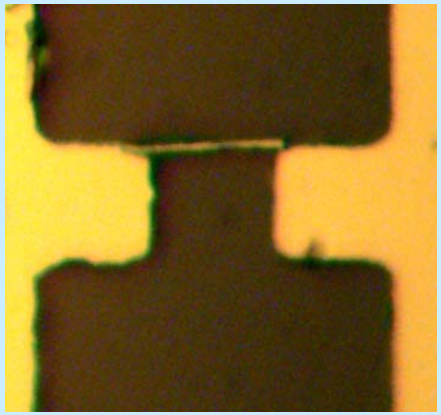
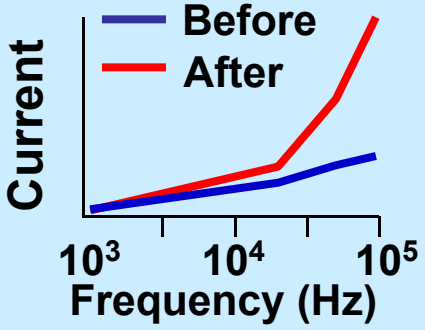
Robert Hamers, Dan van der Weide, and Lloyd Smith are using biologically-modified nanotubes and nanowires as the basis for a new generation of biological sensors.

Selective biomolecular binding can change electrical properties of electrodes and can be used to induce nanowires and nanotubes to bridge across microscopic gaps, forming nanoscale bio-electronic switches.

Ongoing efforts are focusing on these and other types of nanoscale biological sensors. Ultimately, these may provide single-molecule sensitivity.



Biotin-modified gold nanowire bridging a gap between two biologically-modified gold electrodes.



Change in current as nanowire bridges across gap

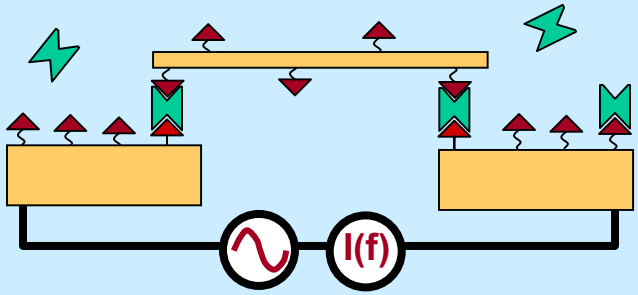


Illustration of bio-electronic switch, with antibodies (green) and antigens (red) linking modified nanowires to gold contacts

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Grad/Undergrad/HighSchool Education:

Four Ph.D. students (Sarah Baker, Kevin Metz, John Peck, and Lu Shang), an undergraduate student (Ms. Fatlume Berisha) and a high school student (Paresh Agarwal) contributed to this work.

Fatlume is a refugee from Kosovo and received a merit-based Dept. of Chemistry scholarship for her research.

Paresh Agarwal spent the entire summer doing research in our labs as part of the Madison Metropolitan School District's Summer Internship Program. He is a National Merit Scholar semifinalist.

Outreach:

Kevin Metz and Robert Hamers mentored an 8th grade student, Justin Balantekin, for 6 weeks as part of the EAGLE School Science Mentor program. Justin learned how to grow metallic nanowires via templated electrochemical deposition inside alumina membranes and assisted in imaging nanowires with a scanning electron microscope.

Dan van der Weide and students organized a "Nanotechnology Expo" day on campus. One day was full of outreach activities for children and adults, including the interactive display zero@wavefunction.