Single molecule transistors

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A team of scientists led by ASU biophysicist Stuart Lindsay, director of the Center for Single Molecule Biophysics at the Biodesign Institute and an ASU professor of physics, recently created the first reproducible single molecule negative differential resistor (NDR).

“NDR is the basis for memories, switches and logic elements,” Lindsay says. “It has been observed in molecules before, but never in controlled conditions, never at low voltages and not in a predictable way.”

Lindsay’s team designed a molecule, called a hepta-aniline oligomer, which belongs to a group of molecules that biochemists believe is capable of being molecular switches but that has failed to exhibit those properties in conductance experiments.

The team solved the problem by developing a technique in which the molecule could be tested in an electrolyte solution, a condition that past experiments didn’t attempt because of interaction problems between the solution and the electrodes.

By using a scanning probe microscope with an insulated probe tip to make and measure single-molecule contacts, with molecules designed to bond at their ends with a surface and the probe tip, the team was able to make reliable connections with single molecules to test their behaviors.

Lindsay stresses that the main value of the work is not in having found a molecule that could be developed into a working electrical switch, but in discovering many critical design parameters that should help in designing

molecular devices.

“We have a working, rational roadmap now for how to do this, and we’re already hard at work applying it to a wide variety of potentially exciting applications,” he says.

ASU researchers presented their findings at the 230th national meeting of the American Chemical Society.

Source: Arizona State University