Gentler processing may yield better molecular devices

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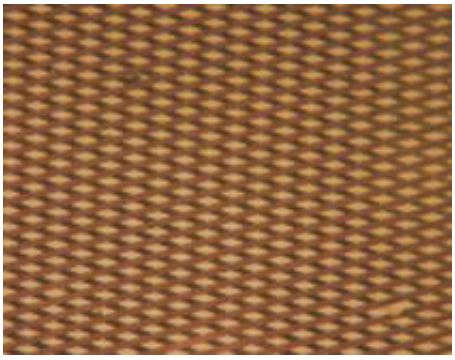

A simple, chemical way to attach electrical contacts to molecular-scale electronic components has been developed by researchers at the National Institute of Standards and Technology (NIST). The recently patented method attaches a layer of copper on the ends of delicate molecular components to avoid damage to the components that commonly occurs with conventional techniques.

Image: Copper contact deposition on organic electronic molecules using the NIST patented process is highly specific, an important feature for building dense arrays of devices. Shown here is a cross-hatched pattern of copper deposits on 10-micrometer-wide, single-layer strips of molecules that have been bound to a gold substrate with microcontact printing.

Molecular electronics--designing carbon-based molecules to act as wires, diodes, transistors and other microelectronic devices--is one of the most dynamic frontiers in nanotechnology. An area equal to the cross-section of a typical human hair might hold about a thousand semiconductor transistors at the current state of art, but up to 13 million molecular transistors.

A key challenge in molecular electronics is making electrical contacts to the fragile molecules, chemical chains that are easily damaged. Currently, this is most often done by vaporizing a metal onto the molecules that stand like blades of grass on a metal substrate. The vaporized metal atoms are supposed to settle on the tops of the molecules but they also often eat away at the delicate structures, or fall through gaps in the "turf" and short out the device. Yields of working devices are typically only a few percent.

NIST researchers designed a technique in which the molecules are synthesized with an additional chemical group attached to the top of the molecule. The chip is immersed in a solution including copper ions, which preferentially bind to the added group, forming a strong, chemically bonded contact that also protects the underlying molecule during further metallic vapor deposition steps. Tests at NIST have demonstrated that the technique works well on surfaces patterned with microcontact printing, producing clean, sharply defined edges, important for the fabrication of practical devices.

Patent: See U.S. patent, no. 6,828,581 available here: patapsco.nist.gov/TS/220/share … tent/pdf/6828581.pdf

Source: NIST