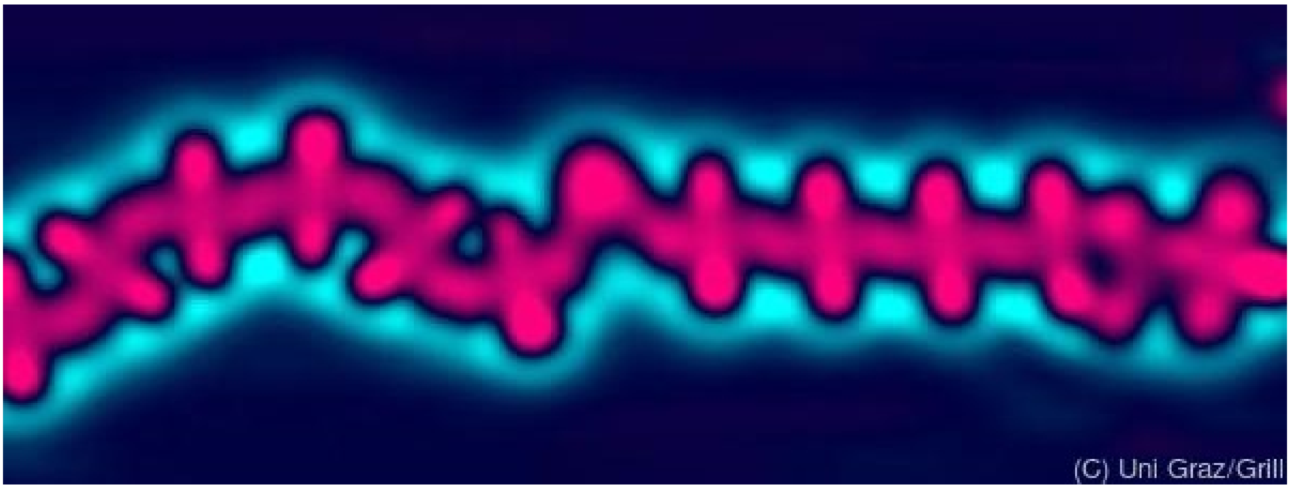
Flexible nanowires: A Berlin-Graz research team develops molecular wires with higher conductivity and bendability

An international team under the direction of Stefan Hecht, who is a member of IRIS Adlershof, and Leonhard Grill from Karl-Franzens-University Graz could develop for the first time molecular chains that have unexpectedly high conductivity in spite of their flexibility. The researchers' new approach will allow the design of flexible nanowires and therefore enable a detailed insight into the relationship between a chemical structure and its electronic and mechanistic properties. This type of conductible and flexible nanowires will be a key component for future logical circuitry in "molecular electronics" and for flexible electronic everyday objects like "wearable plastic electronics." This study has appeared in the current issue of the Nature Communications.



The miniaturization of electronic building blocks has been relentlessly advancing for five decades. Meanwhile little "smart" cell phones have more computing power than entire computer centers from the early days. Each electronic device basically controls the charge current with transistors and circuit boards. Ultimately molecular switches and wires (molecular electronics) will reduce the size of these objects even further, but there still has to be high conductivity to ensure the electrical contact between the individual molecules. Furthermore, they should be bendable enough to adapt to flexible bases. The approaches followed so far have greater conductivity because of the stiffer wire structures, which are inherently rigid with a resultant lack of flexibility. Stefan Hecht's group has introduced an alternative approach in their recent work. In cooperation with Leonhard Grill's group, the researchers used the jointly developed surface polymerization and single-wire characterization (Science 2009, 323, 1193) to create molecular chains from alternating electron-rich and electron-poor units. The resulting alternating donor-acceptor polymers have excellent conductivity without loss of flexibility and in spite of the fact that the electrons are poorly distributed over the wire molecule.

The latter was unexpected and contradicts the commonly known model in which delocalization of the electrons over the molecule was the only guarantee for an efficient charge transport.

Stefan Hecht, a professor of organic chemistry and functional materials at the Humboldt-University zu Berlin, says, "Our study has contributed to the basic understanding of electronic transport by individual molecules and should help the design of new and better molecular wires," which, he hopes, will be an important impulse for the whole field of molecular and organic electronics.

This work was done within the framework of the EU project AtMol, "Atomic scale and single molecule logic gate technologies" in cooperation with researchers at Karl-Franzens-Univeristät Graz as well as at the French CNRS Institute CEMES in Toulouse and the Institute of Materials Research and Engineering (IMRE) in Singapore.

The results have been published in the journal Nature Communications:

Conductance of a single flexible molecular wire composed of alternating donor and acceptor units
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