Study results pave the way to programmable electronic inks

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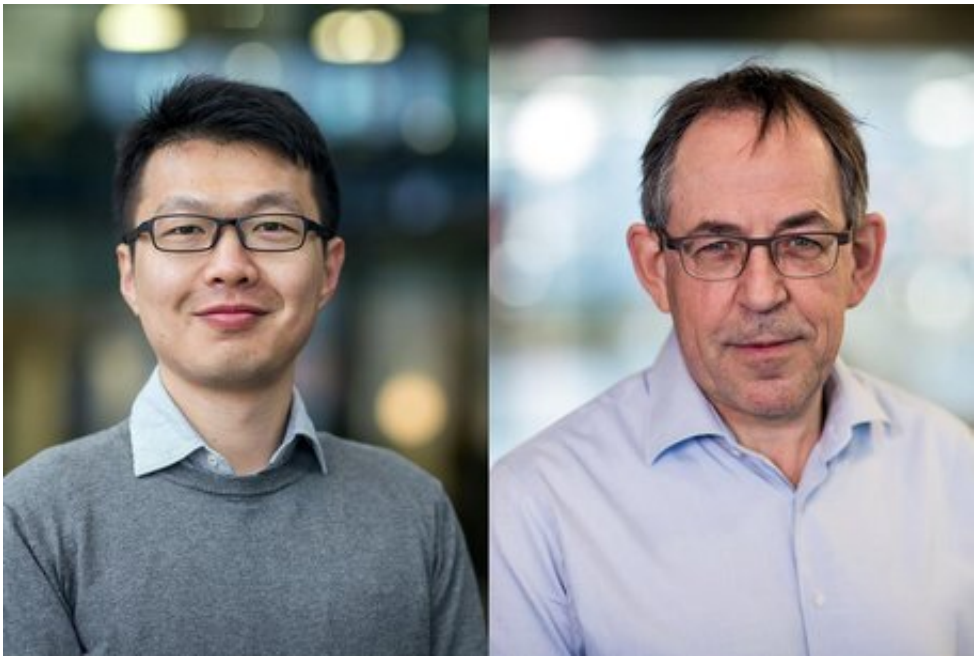

Mengmeng Li and René Janssen. Credit: Eindhoven University of Technology

Conjugated polymers are important materials because of their special electronic and optical properties and low cost, making them very promising for a wide range of applications. An international research team led by Professor René Janssen developed a method to create two subtypes of one polymer, with different semiconductor characteristics, simply by changing the solvent from which the polymer film is created. This opens the door to the development of programmable electronic

inks. The results are published today in *Nature Communications*.

In conjugated polymers some electrons can roam freely. This not only gives them special electronic and optical properties, but these properties can also easily be tuned. Conjugated polymers are, for example, attractive semiconductors for photovoltaic cells because they are strong absorbers of light and can be deposited on flexible substrates at low cost. This deposition is done by putting a polymer solution on a substrate. The eventual structure, and hence the electronic characteristics of the polymer, can be influenced by the choice of solvent and its evaporation.

Precisely tuning the solvent can be used to generate clearly different semiconducting behavior of one type of conjugated polymer, write Mengmeng Li and René Janssen from the DIFFER-TU/e research group in the leading journal *Nature Communications*. Working in an international research team, they point out that these results open up the possibility to make electronic devices by patterning the same polymeric material but having locally different structural and optical properties.

René Janssen: "Although this so-called polymorphic behavior of materials is not new, the novelty of this work is the extent by which we can control the formation of the two polymorphs and the difference in their properties." The research team works with large organic molecules with a backbone of alternating single and double bonds (the so-called conjugated polymers) that are very interesting because of their useful optical and electronic properties. Mengmeng Li: "Special is that we managed to effectively tune their properties in aggregated or semi-crystalline phases by controlling the solvent conditions."

In the paper, the researchers show their polymorphic control in practice by fabricating polymer solar cells and field-effect transistors, a key building block for many integrated electronic circuits. René: "I am intrigued by realizing that these results help paving the way towards

programmable inks, using only one polymer to make two different semiconductors and create rather complex electronic devices in a simple way."

More information: Mengmeng Li et al. Impact of polymorphism on the optoelectronic properties of a low-bandgap semiconducting polymer, *Nature Communications* (2019). DOI: 10.1038/s41467-019-10519-z

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