Flexible electronics hold promise for consumer applications

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Physics professor Oana Jurchescu and grad students Jeremy Ward and Katelyn Goetz (left to right)

(PhysOrg.com) -- New research from Wake Forest University has advanced the field of plastic-based flexible electronics by developing, for the first time, an extremely large molecule that is stable, possesses excellent electrical properties, and inexpensive to produce.

The technology, developed by Oana Jurchescu, assistant professor of physics at Wake Forest, her graduate students Katelyn Goetz and Jeremy Ward, and interdisciplinary collaborators from Stanford University, Imperial College (London), University of Kentucky and Appalachian State University, eventually may turn scientific wonders – including artificial skin, smart bandages, flexible displays, smart windshields, wearable electronics and electronic wallpapers – into everyday realities.

Jurchescu says plastic or organic semiconductors, produced in large volume using roll-to-roll processing, inkjet printing or spray deposition, represent the "electronics everywhere" trend of the future.

In the current consumer market, however, the word "electronic" is generally associated with the word "expensive." This is largely because products such as televisions, computers and cell phones are based on silicon, which is costly to produce. Organic electronics, however, build on carbon-based (plastic) materials, which offer not only ease of manufacturing and low cost, but also lightweight and mechanical flexibility, says Jurchescu.

The team recently published its manuscript in *Advanced Materials*, one of the most prestigious journals in the field of materials research.

Prior researchers predicted that larger carbon frameworks would have properties superior to their smaller counterparts, but until now there has not been an effective route to make these larger frameworks stable and soluble enough for study.

"To accelerate the use of these technologies, we need to improve our understanding of how they work," Jurchescu says. "The devices we study (field-effect transistors) are the fundamental building blocks in all modern-based electronics. Our findings shed light on the effect of the structure of the molecules on their electrical performance, and pave the way towards a design of improved materials for high-performance, low-cost, plastic-based electronics."

Jurchescu's lab is part of the physics department and the Center for Nanotechnology and Molecular Materials.

The team studied new organic semiconductor materials amenable to transistor applications and explored their structure-property

relationships. Organic semiconductors are a type of plastic material characterized by a specific structure that makes them conductive. In modern electronics, a circuit uses transistors to control the current between various regions of the circuit.

The results of the published research may lead to significant technological improvements as the performance of the transistor determines the switching speed, contrast details, and other key properties of the display.

More information: Journal paper: onlinelibrary.wiley.com/doi/10 … a.201101619/abstract

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