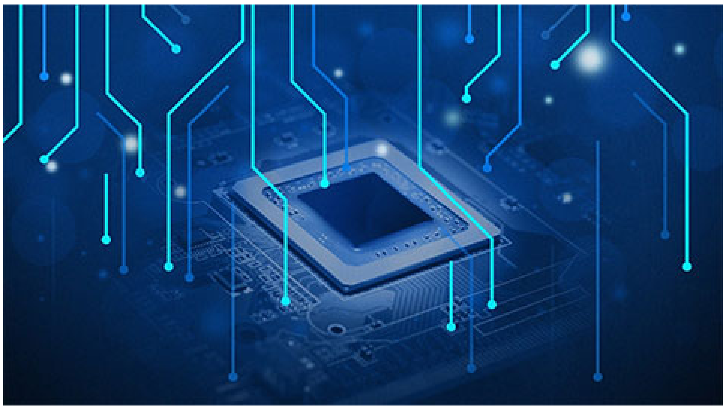
Scientists propose new semiconductors for the electronics of the future

Researchers of Siberian Federal University and their Ukrainian and Swedish partners have proposed a new class of nanostructures based on planar heterocyclic molecules of tetratio- and tetraseleno[8]circulenes. The structures have flexibly varying semiconductor properties and can be used to produce organic LEDs. The results are published in New Journal of Chemistry.



One-dimensional and two-dimensional polymers are currently a rapidly developing scientific industry due to their potential application in organic electronics, which has advantages over inorganic semiconductors. These materials are promising for manufacturing of organic LEDs, various sensors and many other devices due to the simplicity and low cost of production. Another great advantage is the diversity of various organic cyclic molecules which are the feedstock for manufacturing.

Organic light-emitting diodes (OLED), in which the proposed nanostructures can find the most likely and effective application, are semiconductor devices created from a number of films of organic origin. They emit a soft uniform light that is pleasant to the eye when an electric current runs through them. Such LEDs are already used in night-vision devices, organic displays are used in digital cameras, cell phones, digital gauges, and on-board computers. In the near future, tech-visionaries are predicting serial production of e-books and tablets with lightweight flexible and thin OLED displays. LG and Samsung are the OLED technology pioneers.

The authors propose using tetratio- and tetraseleno[8]circulenes to produce the polymers. Circulenes are macrocyclic arenes in which a central polygon is completely surrounded and fused by benzenoids forming a flower-like structure. Such molecules can be interconnected in one-dimensional ribbons or two-dimensional sheets, and the properties of the material will vary depending on its size. The scientists have studied the change in the optoelectronic properties of ribbons depending on their size and how the molecules in them are interconnected.

> *'We've found that the entire family of the materials proposed has significant flexibility in their properties. For example, having only one type of molecule as the initial building block, it is possible to obtain semiconductors with different conductive and optical properties due to the quantum-size effect arising from the limited motion of electrons in small objects. Because of the unusual structure, the new polymers have very high plasticity, which makes them promising for the production of smart clothes that can interact immediately with the environment (for example, built-in flexible solar cells, various sensors and flexible displays),'* explained **Artyom Kuklin**, research engineer of the Laboratory for Basic Research, Department of Science and Innovation, SibFU.

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