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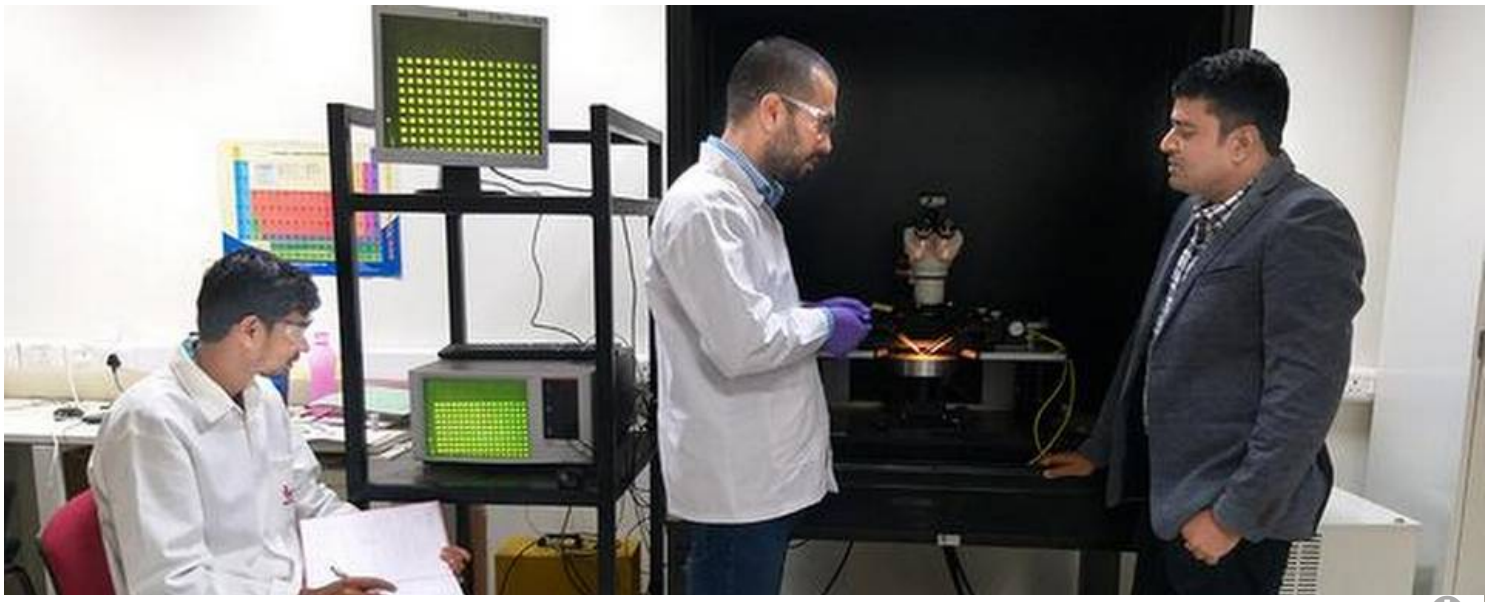
SCIENCE

IISER Pune team fabricates a viable alternative to silicon diodes



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The device shows high electrical conductivity and also high current rectification ratio

Researchers at the Indian Institute of Science Education and Research (IISER) Pune have fabricated a non-silicon, organic–inorganic hybrid diode that not only shows high electrical conductivity but also high current rectification ratio. The current rectification ratio obtained is comparable with commercial silicon diodes. A diode allows current to flow in only one direction. A diode is said to have a high current rectification ratio when the flow of current in one direction is manifold high compared with the current flow in the reverse direction.

In the case of silicon diodes, the current rectification ratio is in the order of 105-108, where 106 denotes one million times. The team led by Nirmalya Ballav from the Department of Chemistry at IISER Pune was able to achieve current rectification ratio close to one million times.

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domain of organic–inorganic hybrid materials like coordination polymers," says Anupam Prasoon from IISER Pune and first author of a paper published in the journal *Chemical Science*. "Earlier studies have been able to achieve rectification ratio of only 102."

The non-silicon diode fabricated by the team was able to demonstrate that the high rectification ratio remained unchanged even at an elevated temperature of about 180 degree C. "This demonstrates that our diode structure is stable even at high temperatures," Prof. Ballav says. The diode displays high water repellence so will be moisture-resistant.

To fabricate the organic–inorganic hybrid diode, the researchers used a commercially available gold-coated silicon wafer as a substrate and functionalised it. The functionalised wafer was dipped in an inorganic solution and then in an organic solution. "We repeated this process for 10 cycles to get a coordination polymer," says Prasoon.

Since the coordination polymer is less conducting and almost behaves like an insulating material, the researchers doped it with a redox-active molecule. The top portion of the coordination polymer is doped while the bottom portion is not. The doped top layer becomes highly conductive. The doped and undoped portions together behave like a p–n junction diode.

The coordination polymers with a modular approach of inorganic and organic layers could make diodes or transistors not only cheaper but also add value in the emerging scenario of flexible electronics, says Prof. Ballav, who has filed a patent application.

"We hope our concept will be useful in the development of semiconducting coordination polymer-based thin film devices for real-world applications," the authors write.

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