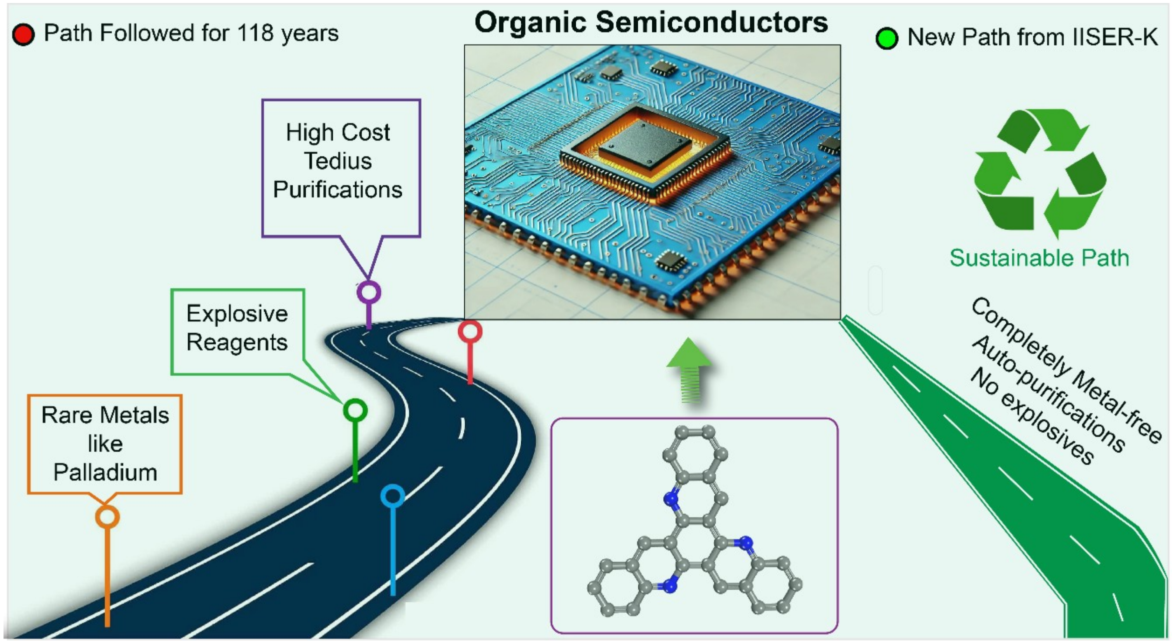
Removing heavy metals from next generation organic semiconductor production – solution towards a 118-year-old problem



To visualize this problem, we first need to know "what is semiconductor and what is their impact in our daily life?".

Semiconductors are materials that conduct electricity only when triggered by certain stimuli, such as light, doping, or voltage. They are essential components in many everyday devices, including mobile phones, computers, and cars. Semiconductors are found in chips, circuits, screens, and more, and they are crucial for advancements in computing, communication, healthcare, transportation, clean energy, and military systems.

But what are these semiconductors made of?

Common materials include silicon, germanium, gallium, and arsenide. These metals are toxic to living organisms; for instance, arsenide is well-known for its toxicity. When we dispose of electronic devices, these metals can be released into the environment, posing a health risk.

To address this issue, scientists worldwide are working to develop semiconductors without these harmful elements. They have discovered that a special class of molecules called polycyclic aromatic hydrocarbons (PAHs) has the potential to replace traditional semiconductor materials. However, producing PAHs currently relies on metals like palladium and lithium, which are rare, valuable, and also toxic.In 1906, a group of German scientists predicted it would be possible to produce PAHs without using any metals, which would be a more sustainable and environmentally friendly solution. For over a century, this prediction remained unproven.Recently, our team has started investigating this problem and has invented a new chemical reaction that completely eliminates the need for metals in the production of PAHs. We have successfully created 30 different types of organic semiconductors using this method, forming them in crystal form. Additionally, we have streamlined the purification process by incorporating an auto-crystallization strategy into our reaction setup.We have also used this innovative method to synthesize graphite with precise pore structures, which is not achievable with conventional methods. We believe these new materials will enable a wide range of applications in organic semiconductors and contribute to a more sustainable world.

To bring this vision to life, we are collaborating with scientists from various institutions, including IIT Hyderabad, IISER Pune, Kyoto University in Japan, and TU Dresden in Germany.

Exciting results from this work has been published in the prestigious journal Nature Synthesis. Here is the link: https://www.nature.com/articles/s44160-024-00590-w

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