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New solar cell tech by IIT Bombay to sharply cut costs, enhance efficiency

The Maharashtra government and ART-PV India Pvt Ltd, a start-up founded at IIT Bombay are working to provide a complete commercial wafer size solution for this technology by December 2027

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The bottom sub-cell uses well-established silicon technology, while the top sub-cell features an indigenously developed halide perovskite semiconductor, enabling high light absorption and efficient energy conversion (Representative image/Archive)

IN WHAT IS seen as a major breakthrough in solar energy technology, researchers at IIT Bombay have developed a high efficiency tandem solar cell with power conversion efficiency

of approximately 30 per cent compared with around 20 per cent now.

This is expected to lead to a 25–30 per cent boost in efficiency over conventional solar technology and potentially reduce cost of solar power at around `1 per kwh compared with ` 2.5-4 per unit now.

The Maharashtra government and ART-PV India Pvt Ltd, a start-up founded at IIT Bombay's Society for Innovations and Entrepreneurship (SINE), are working to provide a complete commercial wafer size solution for this technology by December 2027.

Praveen Pardeshi, Chief Economic Advisor to the Maharashtra Chief Minister, said they have asked Mahagenco, a state-owned power producing company to explore commercialisation avenues. "It will help substantially reduce India's dependence on raw material imports from China," he told *The Indian Express*.

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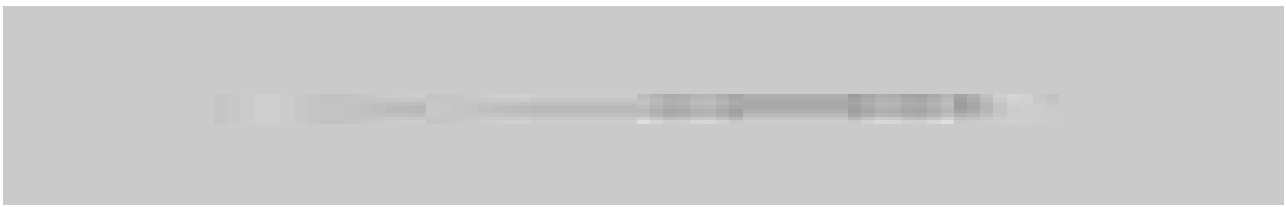
The IIT researchers at the institute's National Centre for Photovoltaic Research & Education (NCPRE) led by Prof. Dinesh Kabra have successfully engineered a semi-transparent perovskite solar cell (PSC) which is layered over a traditional silicon-based solar cell, forming a 4-terminal (4T) tandem structure.



The bottom sub-cell uses well-established silicon technology, while the top sub-cell features an indigenously developed halide perovskite semiconductor, enabling high light absorption and efficient energy conversion. “Halide perovskite is among the most efficient light-absorbing materials known today. Apart from being highly efficient in converting light into electricity, it is affordable as electronic grade perovskite semiconductors can be produced locally with available chemical resources,” explained Prof. Kabra explained.

“Perovskite has long shown promise, but its short lifespan was a major limitation. IIT Bombay’s work extends that life to up to ten years, which is a game-changer. More importantly, as opposed to the current hold of China on required raw materials for the same, perovskite is not subject to geopolitical supply constraints. We’ve asked MAHAGENCO to explore commercialization avenues for this technology,” Pardeshi said.

Despite this impressive potential along with low manufacturing, perovskite materials have faced challenges in long-term stability, particularly when exposed to heat, light, and prolonged electrical stress. Traditional silicon cells typically last 20–25 years, whereas perovskite cells were known to degrade much faster. To address this, the IIT Bombay team devised a novel 4-terminal tandem configuration – two for each layer in the tandem device – allowing both layers to operate independently and efficiently under different conditions.

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“Our stable 4T silicon/perovskite tandem device maintains its performance even under heat and low-light environments, offering not just higher efficiency but also improved durability,” Prof Kabra said.

He said this breakthrough is especially critical for India, which has high population density and limited land resources. “With our indigenous solution, we can generate more power from fewer solar panels, allowing better land utilization and lowering the overall cost of solar electricity. This technology has applications beyond solar farms—including rooftops, vehicle-integrated photovoltaics (VIPV), and building-integrated photovoltaics (BIPV),” Prof Kabra said.

IIT Bombay is also working with the Government of Maharashtra on an initiative to develop clean energy solutions, focusing particularly on green hydrogen production. This project, to be based in Uran, aims to harness cutting-edge solar technology for sustainable green hydrogen generation. Prof. Kabra emphasised the need for solar cells with high open-circuit voltage to efficiently produce green hydrogen. “While there are compound semiconductors

which are able to meet requirements, they are costly and dependent on critical raw materials largely controlled by China. Perovskite-based tandem cells have the potential to deliver solar-to-hydrogen (STH) efficiencies comparable to compound semiconductors—at a fraction of the cost and with materials more accessible to India," he said pointing out that as this technology matures, it could become superior in performance.

While Maharashtra government is exploring commercialisation avenues, a start-up ART-PV India Pvt. Ltd. which was founded at IIT Bombay's Society for Innovations and Entrepreneurship (SINE); is already working to provide a complete commercial wafer size solution for this technology by December 2027. Prof. Kabra, who is also heading the company, said, "It will be done using indigenous equipment solutions."

Prof. Kabra noted that ART-PV India has a Maharashtra based equipment manufacturing partner, who specializes in making high thin-film deposition tools.

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