# A leap forward in nanotechnology: Growing special micro-crystals for better devices

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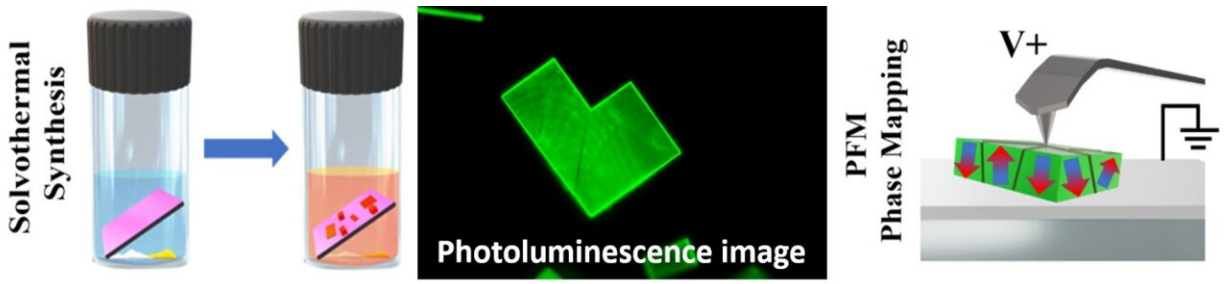


$CsPbBr_3$ nanoplatelets grown using a new solvothermal method demonstrate excellent optoelectronic and ferroelectric properties. Credit: Dr. Atikur Rahman

In a paper published in the journal *Advanced Materials*, Dr. Atikur Rahman's research group from the Physics department at IISER Pune, India, along with collaborators, report a new way to grow special crystals called $CsPbBr_3$ nanoplatelets.

The superior properties of these crystals make them promising candidates for use in photodetectors and electronic devices. The collaborators on this work included the research groups of Prof. Pavan Kumar from IISER Pune, Dr. Goutam Sheet from IISER Mohali, and Dr. Sooyeon Hwang from Brookhaven National Laboratory, U.S..

$CsPbBr_3$ is a type of material that has excellent optoelectronic

properties. This means it can interact with light in ways that are very useful for devices like solar cells, light-emitting diodes (LEDs), and detectors. These crystals are stable at high temperatures, making them durable and reliable.

However, until now, scientists have had trouble growing large, high-quality $CsPbBr_3$ crystals with ferroelectric properties and ultralow dark current. This has limited the use of $CsPbBr_3$ crystals in new technologies that could take advantage of their unique properties, such as optical switches, ultrasensitive detectors and advanced solar cells.

In the current paper, the team developed a novel method to grow these crystals near room temperature using a process called solvothermal synthesis. This technique involves using a special solution to dissolve the materials needed to form the crystals.

"One of the most exciting aspects of this method is that the crystals grown using this method show ferroelectric properties," said Gokul Anilkumar, a Ph.D. student with Dr. Rahman and the first author on this study.

Ferroelectric materials have a special ability to maintain an electric polarization, which can be reversed by applying an electric field. This makes them very useful for various advanced technologies.

The researchers used several sophisticated techniques, such as Second Harmonic Generation (a method to test if the crystals can generate new light frequencies) and Piezoresponse Force Microscopy (a technique to measure the mechanical response of the crystals to electrical fields) to confirm that the crystals are indeed ferroelectric.

By making microdevices, the researchers tested the crystals' electrical conductivity and found they allow very low current to flow in the dark,

which means they can detect very low levels of light or radiation. These devices are found to be 100 times more sensitive than conventional silicon photodetectors.

Speaking on the potential applications of this development, Dr. Atikur Rahman, who led this collaborative work, said, "The ability to grow high-quality $CsPbBr_3$ microcrystals is a major step forward in materials science. It paves the way for the development of next-generation optoelectronic devices, such as more efficient LEDs and ultrasensitive sensors for light and X-ray or other radiation, which could transform how we use and generate energy."

**More information:** Gokul M. Anilkumar et al, Near Room Temperature Solvothermal Growth of Ferroelectric CsPbBr3 Nanoplatelets with Ultralow Dark Current, *Advanced Materials* (2024). DOI: 10.1002/adma.202403875

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