Study finds $CsPbBr_3$ out-of-phase perovskite helps highly sensitive X-ray detection

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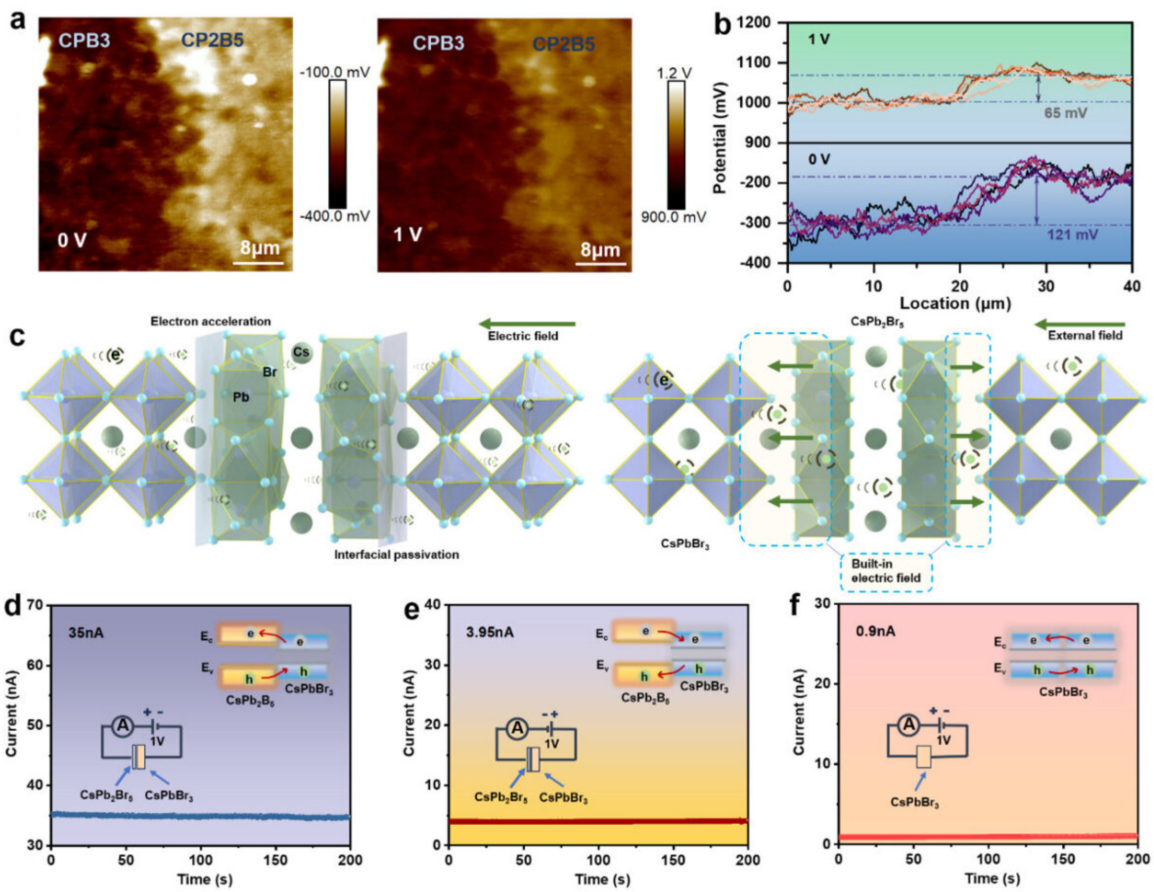

The introduction of $CsPb_2Br_5$ enhances the transport of charge carriers within $CsPbBr_3$. Credit: WANG Changmao

A recent study conducted by the research team at Hefei Institutes of

Physical Science of the Chinese Academy of Sciences, has introduced a new method for enhancing X-ray detection by incorporating out-of-phase $CsPb_2Br_5$ perovskite into $CsPbBr_3$ bulk material.

"We achieved really good sensitivity for detecting X-rays (2.58×10^5 μC Gyair-1 cm^{-2}), and a low detection limit (127.9 nGy_{air}^{-1})," said Prof. Pan Xu, who led the team, "We also integrated this technique with a thin-film transistor (TFT) plate to make X-ray images."

The relevant results were published in *Advanced Functional Materials*.

Metal halide perovskite is a promising material for detecting things like X-rays, offering better sensitivity and resolution than traditional detectors. Inorganic perovskite $CsPbBr_3$ has excellent environmental stability and unique high-temperature plasticity, rendering it particularly advantageous for X-ray detector and imaging applications.

However, making single-crystal $CsPbBr_3$ is difficult and expensive, and polycrystalline $CsPbBr_3$ devices have low electron mobility, limiting their use in certain imaging systems.

In this study, scientists developed a new method called the Out-of-Phase Articulation Strategy (OPAS). They used OPAS to combine a special material called $CsPb_2Br_5$ with another material called $CsPbBr_3$. They made a mixture of these materials using a technique called high-energy mechanical ball milling. Adding $CsPb_2Br_5$ didn't decrease the current baseline.

Instead, it helped to speed up the movement of electrons and holes, which are important for detecting X-rays. This improvement was possible because $CsPb_2Br_5$ created pathways for the electrons and holes to move more easily within $CsPbBr_3$. Using this method, they achieved high sensitivity and spatial resolution for detecting X-rays without needing a lot of voltage.

In addition, the researchers put together $CsPb_2Br_5/CsPbBr_3$ on TFT backplanes to realize multi-pixel X-ray surface-array imaging. This proved that $CsPbBr_3$ material can be used for imaging.

"It also gives us a new material system and design concept for using chalcocite in X-ray imaging," added Ye.

This work shows that perovskites with the introduction of a 2D phase exhibit carrier transport effect and good long-term stability which making them promising candidates for commercial use.

More information: Changmao Wan et al, Out-Of-Phase Articulation Strategy of CsPbBr3/CsPb2Br5 Perovskite for High Sensitivity X-Ray Detection, *Advanced Functional Materials* (2024). DOI: 10.1002/adfm.202401220

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