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## Scientists Reveal Dynamic Mechanism of Lead-Free Quadruple Perovskite Nanocrystals

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In recent years, lead-free halide perovskite nanocrystals have drawn more and more attention due to their low toxicity, high stability and chemical diversity. It's important to reveal the carrier dynamics of lead-free perovskite nanocrystals to apply them effectively in the field of optoelectronic devices.

A research group led by Prof. HAN Keli from the [Dalian Institute of Chemical Physics](#) of the Chinese Academy of Sciences ([CAS](#)) revealed the luminescence enhancement mechanism of a series of new lead-free quadruple halide perovskite nanocrystals, and prepared high-performance photodetectors. This study was published in [Adv. Mater.](#) on Jan. 25.

The researchers reported for the first time a series of quadruple perovskite colloidal nanocrystals with ordered vacancies. By alloying Cs<sub>4</sub>MnBi<sub>2</sub>Cl<sub>12</sub> nanocrystals, the fluorescence quantum yield could be increased by nearly 100 times.



Efficient luminescent halide quadruple-perovskite nanocrystals via trap-engineering for highly sensitive photodetectors.

Through carrier ultrafast dynamics studies, the researchers found that in the quadruple perovskite nanocrystals, free excitons were rapidly self-trapped as "self-trapped excitons", and a self-trapped exciton-assisted donor-acceptor (Mn<sup>2+</sup>) occurred energy transfer process. Alloying could eliminate the ultra-fast defect state trapping process that competed with energy transfer, and increase the crystallinity of the nanocrystals, thereby improving the luminous efficiency.

Based on the alloyed quadruple perovskite nanocrystals with high crystallinity and long carrier lifetime, the researchers prepared a photodetector, which had ultra-high responsivity. Its sensitivity was much higher than that of the previously reported photodetectors based on lead-free perovskite nanocrystals.

The study shows that the quadruple perovskite type nanocrystal opens up new possibilities for photovoltaic applications. It was supported by the National Natural Science Foundation of [China](#).

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