ACHIEVEMENTS

Chirality-Driven Spin Photocatalysis for Artificial Photosynthesis

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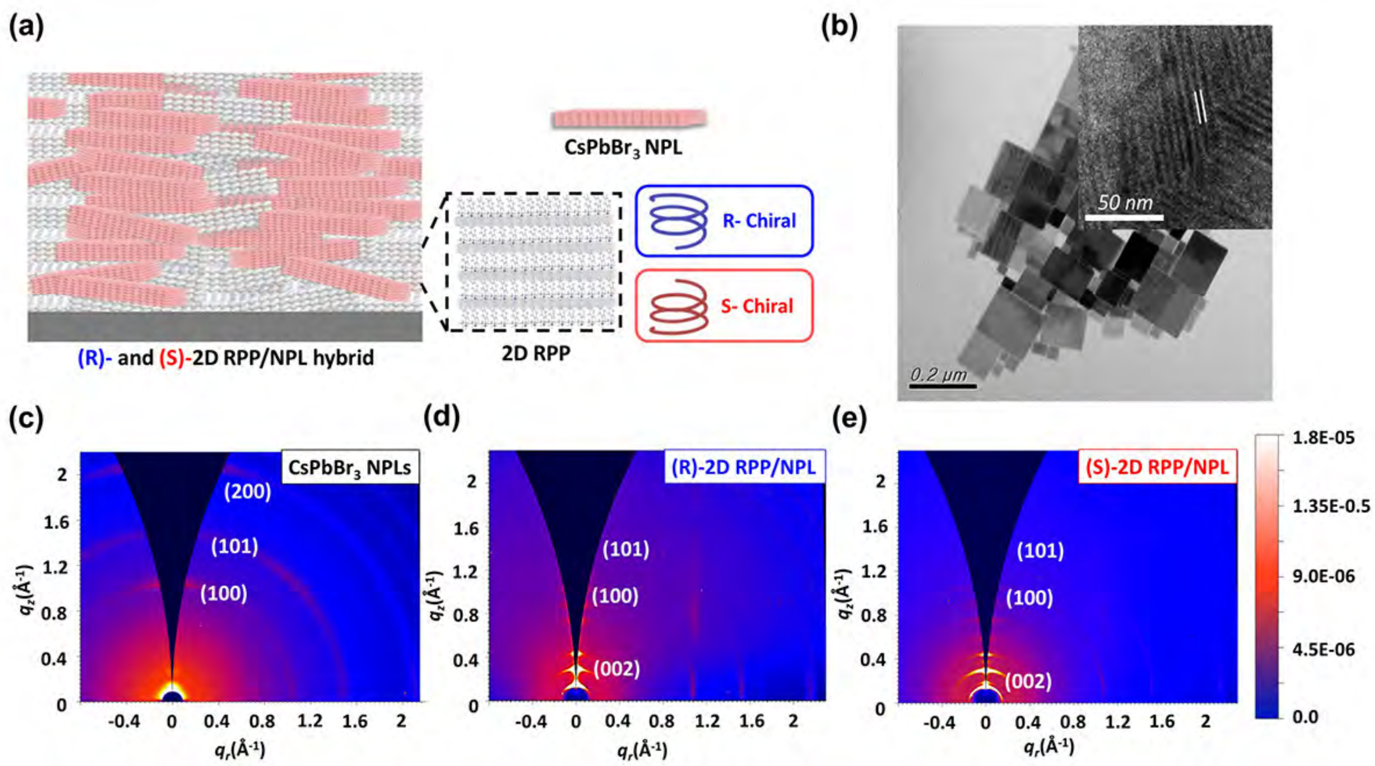

Charts and images of the morphology and structural characteristics of chiral perovskite nanocrystals.

A research team led by Distinguished Professor Chun-Wei Chen of the Department of Materials Science and Engineering and the International Graduate Program in Molecular Science and Technology (NTU-MST) at National Taiwan University has developed chiral perovskite photocatalytic materials, opening a new path for artificial photosynthesis through the integration of chirality and electron spin effects. Their work demonstrates an efficient photocatalytic strategy for converting carbon dioxide into value-added fuels using solar energy, offering a promising approach to sustainable energy conversion.

The research introduces left-handed and right-handed chiral molecules into $CsPbBr_3$ perovskite nanocrystals, enabling precise control over electronic spin states during photocatalytic reactions. The resulting chiral perovskites exhibit strong chiroptical responses, which facilitate the generation of spin-polarized electrons in the illumination of light. This chirality-regulated spin polarization significantly enhances the efficiency of photocatalytic CO_2 reduction by promoting selective reaction paths and improving charge utilization.

The study further demonstrates that chirality-induced spin polarization in organic–inorganic hybrid perovskite thin films suppresses charge-carrier recombination. By prolonging the lifetime of photogenerated electrons and holes, the overall photocatalytic performance is markedly improved. These findings offer compelling experimental evidence that spin polarization plays a decisive role in governing photocatalytic reaction kinetics and efficiency.

More importantly, this work establishes spin control as a new design principle for photocatalysis and energy conversion. By synergistically coupling chiral molecular structures with spin physics, the study opens a new research direction in chiral optoelectronic materials. The proposed strategy carries broad implications for solar energy conversion, photocatalytic water splitting, and green energy catalysis, thus offering a fresh framework for the development of next-generation photocatalysts.

This breakthrough research was recently published in the *Journal of the American Chemical Society (JACS)* and was selected as the journal's front cover, underscoring its scientific significance and impact.

Click or scan the QR code to read the full article in Journal of the American Chemical Society.

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