Experimentelle Physik 2

Seminar Festkörperphysik (CMP Seminar)

Aktuelle Probleme der Festkörperphysik für Studenten und Mitarbeiter
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Controlling of charge separation and radiative recombination dynamics in lead halide perovskite quantum dots

Rongrong Hu[1,2]

[1] *School of Science, Shanghai Institute of Technology, Shanghai, China,*

[2] *State Key Laboratory of Precision Spectroscopy, East China Normal University, Shanghai, China*

All-inorganic lead halide perovskite quantum dots (PQDs) have attracted significant attention due to their exceptional optoelectronic properties and unique spin-related behaviors. In this presentation, we focus on the manipulation of charge separation and radiative recombination dynamics in perovskite quantum dots. Using a spin-detection–based POP technique, we directly observe charge-separated and evolution dynamics in perovskite QDs [1-3], revealing ultrafast carrier trapping and detrapping dynamics. In addition, by combining ultrafast spectroscopic techniques with surface ligand engineering or doping strategies, we enhanced photoluminescence performance of perovskite QDs [4,5].

[1] Cheng, L.; et al., Multiscale Dynamics from Picoseconds to Milliseconds: Bridging Spin Coherence and Metastable Photocharging in $CsPbX_3$ Perovskite Quantum Dots. *Nano Lett.* **25**, 11895–11901 (2025).

[2] Cheng, L.; et al., Extremely Long-Lived Charge Separation and Related Carrier Spin Excitation in $CsPbBr_3$ Perovskite Quantum Dots with an Electron Acceptor Benzoquinone. Nano Res. **17**, 10649-10654 (2024).

[3] Li, X.; et al., Copper Doping Enables Superior Charge Separation for Enhanced Spin Coherence and CO_2 Photoreduction in $CsPbBr_3$ Quantum Dots. *J. Phys. Chem. Lett.* **16**, 10363-10370 (2025).

[4] Hu, R.; et al., Enhancement of Photoluminescence in $CsPbBr_3$ Nanocrystals with 1-Octanethiol by Light Illumination for Potential Emitting Applications. *ACS Appl. Nano Mater.* **7**, 12903– 12910 (2024).

[5] Peng, W.; et al., Solution-Grown Millimeter-Scale Mn-Doped $CsPbBr_3/Cs_4PbBr_6$ Crystals with Enhanced Photoluminescence and Stability for Light-Emitting Applications. *Phys. Chem. Chem. Phys.* **26**, 373– 380 (2024).