Colloidal nanomaterials for light

Andrey L. Rogach
Department of Materials Science and Engineering & Centre for Functional Photonics, City University of Hong Kong, Hong Kong S.A.R.

I will provide an overview on synthesis, optical spectroscopy, and applications of light-emitting colloidal nanomaterials recently (2022-2024) synthesized in our labs, which include CuInSe-based [1] and HgTe nanorods [2] emitting over the broad visible and infrared spectral range, carbon dots [3], and perovskite nanocrystals [4]. I will highlight their photophysical properties studied by advanced optical spectroscopy techniques, and demonstrate their applications in light-emitting diodes [3,5,6] and photodetectors [2,7].

References

1. A. S. Portniagin, J. Ning, S. Wang, Z. Li, A. A. Sergeev, S. V. Kershaw, X. Zhong, A. L. Rogach. Monodisperse $CuInS_2$/CdS and $CuInZnS_2$/CdS Core-Shell Nanorods with a Strong Near-Infrared Emission. Adv. Opt. Mater. 10 (2022) 2102590.
2. A. S. Portniagin, K. A. Sergeeva, S. V. Kershaw, A. L. Rogach. Cation-Exchange-Derived Wurtzite HgTe Nanorods for Sensitive Photodetection in the Short-Wavelength Infrared Range. Chem. Mater. 35 (2023) 5631-5639.
3. S. A. Cherevkov, E. A. Stepanidenko, M. D. Miruschenko, A. M. Zverkov, A. M. Mitroshin, I. V. Margaryan, I. G. Spiridonov, D. V. Danilov, A. V. Koroleva, E. V. Zhizhin, M. V. Baidakova, R. V. Sokolov, M. A. Sandzhieva, E. V. Ushakova, A. L. Rogach. Amphiphilic Acetylacetone-Based Carbon Dots. J. Mater. Chem. C, 2024, 12, 3943-3952.
4. Q. Zeng, X. Zhang, Q. Bing, Y. Xiong, F. Yang, H. Liu, J.-Y. Liu, H. Zhang, W. Zheng, A. L. Rogach, B. Yang. Surface Stabilization of Colloidal Perovskite Nanocrystals via Multi-Amine Chelating Ligands. ACS Energy Lett. 7 (2022) 1963-1970.
5. W. Dong, X. Zhang, F. Yang, Q. Zeng, W. Yin, W. Zhang, H. Wang, X. Yang, S. V. Kershaw, B. Yang, A. L. Rogach, W. Zheng. Amine-Terminated Carbon Dots Linking Hole Transport Layer and Vertically Oriented Quasi-2D Perovskites through Hydrogen Bonds Enable Efficient LEDs. ACS Nano 16 (2022) 9679-9690.
6. J. Guo, M. Lu, X. Zhang, S. Sun, C. Han, Y. Zhang, X. Yang, S. V. Kershaw, W. Zheng, A. L. Rogach. Highly Stable and Efficient Light-Emitting Diodes Based on Orthorhombic γ-CsPbI3 Nanocrystals. ACS Nano 2023, 17, 9290-9301.
7. K. A. Sergeeva, S. Hu, A. V. Sokolova, A. S. Portniagin, D. Chen, S. V. Kershaw, A. L. Rogach. Obviating Ligand Exchange Preserves the Intact Surface of HgTe Colloidal Quantum Dots and Enhances Performance of Short Wavelength Infrared Photodetectors. Adv. Mater. 2024, 36, 2306518.