Wednesday, April 3, 2024 – 10.30 a.m.

Department of Materials Science U5 - Seminar room – 1 st floor

The Strategies to Stabilize Quantum Dots

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In recent years, Quantum Dots (QDs) have been regarded as outstanding emitters for in the fields of light-emitting diodes (LEDs), lighting, backlit displays and bio-imaging due to their high photoluminescence quantum yield, narrow full width at half maximum, and tunable emission color over the visible spectrum. However, due to their ionic structure and low formation energy, their intrinsic poor stabilities under external environmental factors such as moisture, oxygen, heat, and light irradiation limits their practical applications. Generally speaking, poor stability, especially photostability, will lead to rapid fluorescence decay during long-term operation. In my talk, I will provide a brief overview of our progress in improving the stability of quantum dots. We have developed a series of coating technologies and surface treatment methods for different types of QDs, especially CdSe and perovskite nanocrystals[1-5], which greatly improved the stabilities of these QDs. We have recently even improved the stability of perovskite quantum dots to the level of ceramic phosphors, and finally enabling the "on-chip" applications of quantum dots, which will pave the way for large-scale, low-cost commercial backlight applications of quantum dots including backlight films, and micro LEDs.

References

(1) Z. Li, W. Yao, & L. Li, General method for the synthesis of ultrastable core/shell quantum dots by aluminum doping. *J. Am. Chem. Soc*. **2015**, 137, 12430.

(2) S. Huang, Z. Li, & Li, L. Enhancing the stability of $CH_3NH_3PbBr_3$ quantum dots by embedding in silica spheres derived from tetramethyl orthosilicate in "waterless" toluene. *J. Am. Chem. Soc*. **2016**, 138, 5749.

(3) Q. Zhang, B. Wang, W. Zheng, & L. LI* et al. Ceramic-like stable CsPbBr3 nanocrystals encapsulated in silica derived from molecular sieve templates. *Nat Commun.* 2020, 11, 31.

(4) M. He, Q. Zhang, & S. Brovelli* L. LI.* et al. Ultra-stable, solution-processable CsPbBr3–SiO2 nanospheres for highly efficient color conversion in μ-LEDs. *ACS Energy Lett.* 2023, 8, 151.

(5) M. Liu, Q. Wan, H. Wang, & S. Brovelli,* L. LI.* et al. Suppression of temperature quenching in perovskite nanocrystals for efficient and thermally stable light-emitting diodes. *Nat. Photo.* 2021, 15, 379.

Biography

Dr. Li is a professor of MIMSE at Macau University of Science and Technology. In 2006, he received his Ph.D. from Shanghai Jiao Tong University, and then engaged in postdoctoral research at CEA, Grenoble, University of California, Santa Barbara, and Los Alamos National Laboratory. In 2011, he joined an LED phosphor company in Silicon Valley as a senior scientist for quantum dot commercialization. In 2013, he returned to Shanghai Jiao Tong University to start his independent research career. In 2022, he moved to Macau and was appointed as a "Jinghai Scholar" professor at Macau University of Science and Technology. In recent years, his research interests have focused on improving the stability of quantum dots and the fabrication of quantum dot-based LED devices. He has published 116 papers (more than 10,000 citations, h-index = 43) in academic journals, including Nature Photonics, Nature Communications, Journal of the American Chemical Society, and others.