Ultra-narrow room-temperature emission from single $CsPbBr_3$ perovskite quantum dots

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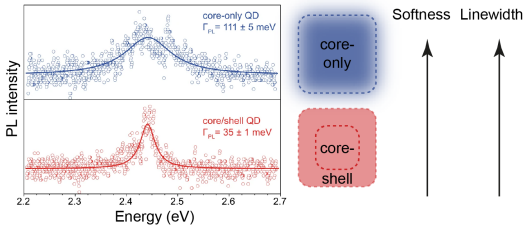
Within only few years since their first synthesis, colloidal perovskite quantum dots (QDs) have already turned into a commercial product. Their facile synthesis, solution-processability, and narrow-band luminescence, spectrally tunable across the entire visible range, are currently being exploited for classical light-emission applications, such as LEDs and displays, as well as quantum light applications, such as single-photon sources. However, continued progress of perovskite-QD based devices cannot evade the question to which extent the pronounced dynamical disorder of the soft perovskite crystal structure limits further advances in light emission, *e.g.,* the quest for every-smaller linewidths in classical applications and single-photon indistinguishability (via coherence) in quantum applications.

In this talk, I will discuss some of our recent insights into exciton-phonon coupling in perovskite QDs.[1][2] Single-QD PL spectroscopy in combination with *ab-initio* molecular dynamics (AIMD) simulations suggest a sizable coupling of the exciton to low-energy surface phonons via the deformation potential. Smaller QDs exhibit stronger coupling and, hence, overall broader emission. However, mild adjustments of the surface chemical composition successfully reduce the emission linewidth from 70-120 meV to 35−65 meV, on par with the lowest linewidths reported for structurally rigid colloidal II-VI quantum dots.



[1] M.I. Bodnarchuk, Simon C. Boehme, et al., *ACS Energy Lett.* **2019**, 4, 1, 63–74
[2] Gabriele Rainò, Nuri Yazdani, Simon C. Boehme, et al., *Nature Communications*, **2022**, 13, 2587