Luminescent perovskites: From materials to light-emitting devices

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The thesis describes the preparation of efficient and simple bright halide perovskite materials and light-emitting devices. In the different chapters, several perovskite types are described and studied: Perovskites with different crystal sizes, from nanosized perovskites (Chapter 2, 3 and 4) to bulk perovskites (Chapter 5) all with a 3D crystal structure; and perovskites with different crystal structure dimensionalities, such as 3D or nanoplatelets with 2D (Chapter 3) and even quasi-2D structures (Chapter 2). Photoluminescence and electroluminescence with colours ranging from red to green and blue are reported.

Chapter 2 focuses on obtaining stable and very PL efficient red-emitting hybrid quasi-2D perovskite NCs with a narrow linewidth. The work experiments with a controllable shift of the bandgap, accomplished by varying the chain length of the alkylammonium ligands employed in its synthesis. (DOI: 10.1039/c9nr04520a)

Chapter 3 describes the novel use of a bifunctional ligand for the synthesis of highly photoluminescent green-emitting $MAPbBr_3$ NPs. Additionally, the ligand allows the nanostructures to effectively anchor on a variety of conducting polymers and inorganic semiconducting surfaces, which is used for the preparation of solution-based multilayer LEDs. (DOI: 10.1039/C6CC05549D)

Chapter 4 is about green-emitting LEDs with a remarkably high combination of EQE, luminance, power and current efficiency. The outstanding performance is described to be due to an energy cascade from hierarchical self-assembled structures. These structures, low-dimensional octylammonium lead bromide microplatelets (MPLs) and 3D $FAPbBr_3$ NCs, form ultra-smooth films with a very high PLQY. (DOI: 10.1039/C8EE00293B)

Chapter 5 describes a mechanochemical synthesis of stable mixed-cation/mixed-halide lead perovskites powders ($MA_{1-y}Cs_yPb(Br_nCl_{1-n})_3$) with emission spanning the green to blue region of the visible spectrum. Upon addition of amantadine hydrochloride, a strong enhancement in the PLQY can be obtained with only minor structural changes. (DOI: 10.1002/adom.201901494)