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Stacking Kinetics of PbS QDs Orientated by Perovskite Matrix during Printing

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PbS colloidal quantum dots (CQDs) have generated great interests in various optoelectronic devices including solar cells, photodetectors and infrared light-emitting diodes (LEDs), due to their size-tunable bandgap, low-temperature and solution processability. To date, defects and charge carrier transport in CQD solids and surface passivation of one single QD remain major challenges for the performance of QD based devices. In our work, we select perovskite constitutes as the ligand precursors to conduct solution ligand exchange for as-synthesized PbS QDs and the final QD powder is dissolved with n-butylamine to obtain QD ink for slot-die printing. In this work, we focus on how QDs capped with different ligands dynamically stack in the phase transition from QDs ink to a film during slot-die printing by grazing-incidence small-angle X-ray scattering (GISAXS). In addition, the post- treatment annealing and heated substrate during the film deposition are investigated to observe the inner structure of QDs film in real time. Grazing-incidence wide-angle X-ray scattering (GIWAXS) and GISAXS are simultaneously used to investigate how the perovskite ligands form into crystals and how the crystalline orientation of perovskite matrix dynamically aligns and influences the QDs stacking behavior in the final film formation.

Primary authors: ZHONG, Huaying; Prof. MÜLLER-BUSCHBAUM, Peter (Technische Universität München (TUM)); Dr CHEN, Wei (Shenzhen Technology University (STU))

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