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Quantum dot solids for photo-devices

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Quantum dots (QDs) with near infrared emission are promising for use in photodetectors (PDs) for sensing and in photovoltaics (PVs) for solar energy conversion. High quality QDs are normally synthesized in solution and capped with organic ligands. To efficiently functionalize the QDs'array for PD or PV devices, the ligand exchange treatments, in solution or on solids, to colloidal QDs are necessary by exchanging or removing the long chain organic ligands. These treatments will not only decrease the inter-dot spacing between neighboring QDs to improve their electro-coupling behavior, which is beneficial for the energy transfer, but also change the stacking behavior of QD particles in solid from colloidal state to close packed state. Herein, we used a halide ions solution to pretreat the surface of QDs in solution before ligand exchange process on solids. The inner structures of ligand exchanged solids are investigated by grazing incidence X-ray scattering (GIXS). The results indicate that, comparing with non-pretreated QD based solids, pretreated QD solids reveal optimized inner structures as a result of the optimized stacking behavior. Thus, the optimized solar cell devices demonstrate better device performances.

Primary authors: CHEN, Wei (Technische Universität München); Prof. MÜLLER-BUSCHBAUM, Peter (Lehrstuhl für Funktionelle Materialien E 13)

Presenter: CHEN, Wei (Technische Universität München)

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