Air-stable PbSe nanocrystal quantum dots via efficient halide passivation

우주영, 고재현, 송정훈[1], 김경남[1], 최혜경[1], 김용현, 이도창, 정소희[1,*]
한국과학기술원; [1]한국기계연구원
(sjeong@kimm.re.kr[*])

PbSe nanocrystal quantum dots (NQDs) have been extensively investigated for various electronic applications such as IR-detectors, lasers, and solar cells. A narrow bulk band gap (0.26 eV), a large exciton Bohr radius (46 nm), size-tunable energy levels, and efficient carrier multiplication (CM) make them suited in such applications. However, susceptibility to oxidation of PbSe NQDs strongly hampers the further development of PbSe-based electronic devices. In this study, we developed simple halide treatment to improve the stability of PbSe NQDs. Absorption, photoluminescence (PL), and X-ray photoelectron spectroscopy (XPS) data reveal that halide treated PbSe NQDs are highly oxidation-resistive in ambient condition. Density functional theory (DFT) calculations support that improved stability of PbSe NQDs with halide treatment is due to the atomically thin halide adlayer formation on PbSe NQD surface. Finally, we fabricated the air stable NQD-based field effect transistors (FETs) via halide treatment.