Supporting information

Counterion-Mediated Ligand Exchange for PbS Colloidal Quantum Dot Superlattices

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Keywords: (colloidal quantum dots, lead sulfide, iodide-capped, transport, ligand exchange)

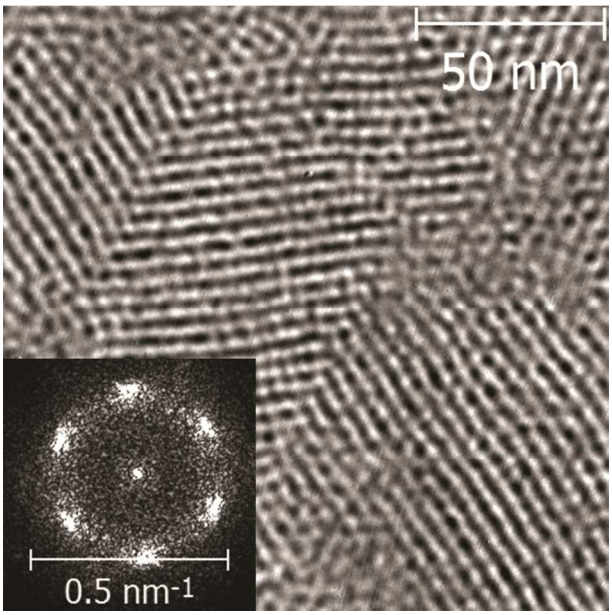

Figure S1. TEM micrographs of PbS CQDs capped with oleic acid. The inset (Fourier-transformed image) confirms the hexagonal arrangement with interparticle distance around 1 nm.

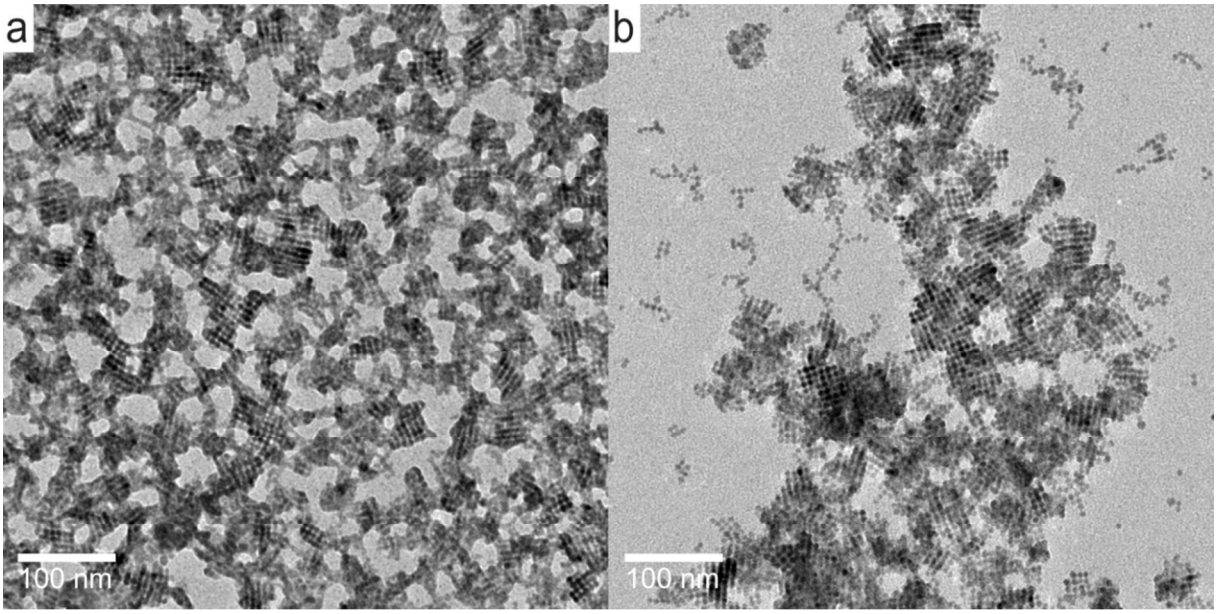

Figure S2. TEM images of $MAPbI_3$-capped PbS CQDs deposited (a) from pure PC and (b) with MFA additive. (c) Radial profiles of Fourier-transformed TEM images for OA-capped PbS CQDs deposited from toluene and $MAPbI_3$-capped PbS CQDs deposited with and without MFA additive.

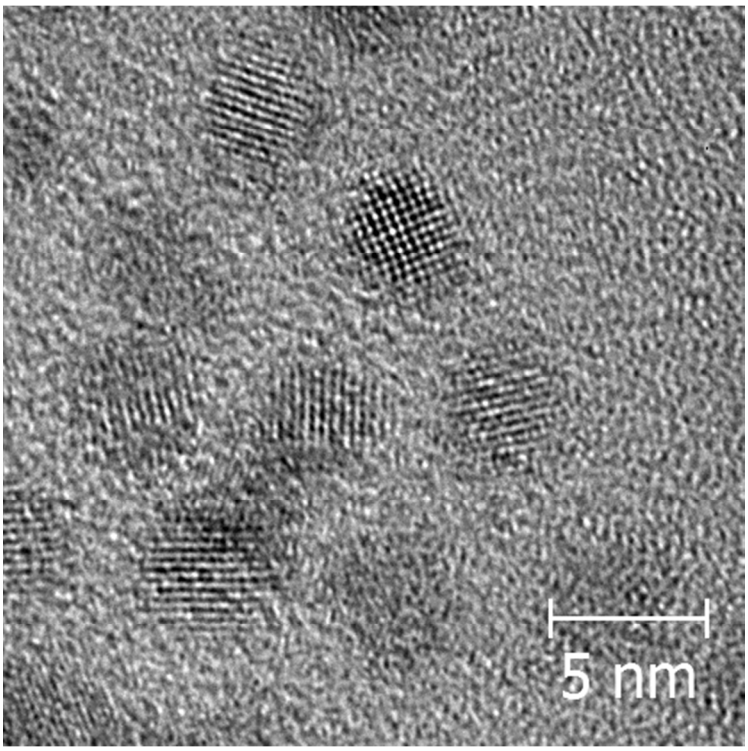

Figure S3. HRTEM image of single PbS CQDs

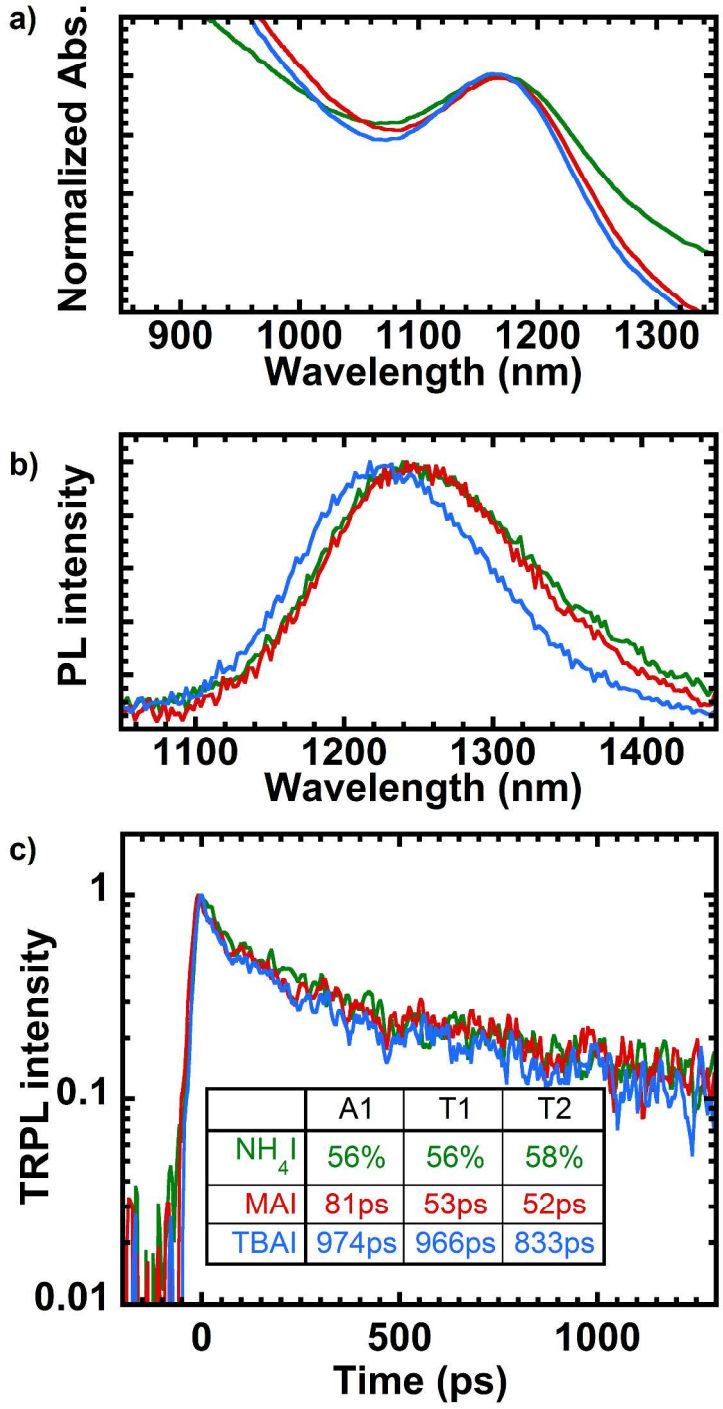

Figure S4. Optical spectroscopy data of thin films prepared with the three salts: a) absorbance b) steady-state and c) time-resolved photoluminescence. The data indicate no difference in the electronic coupling.

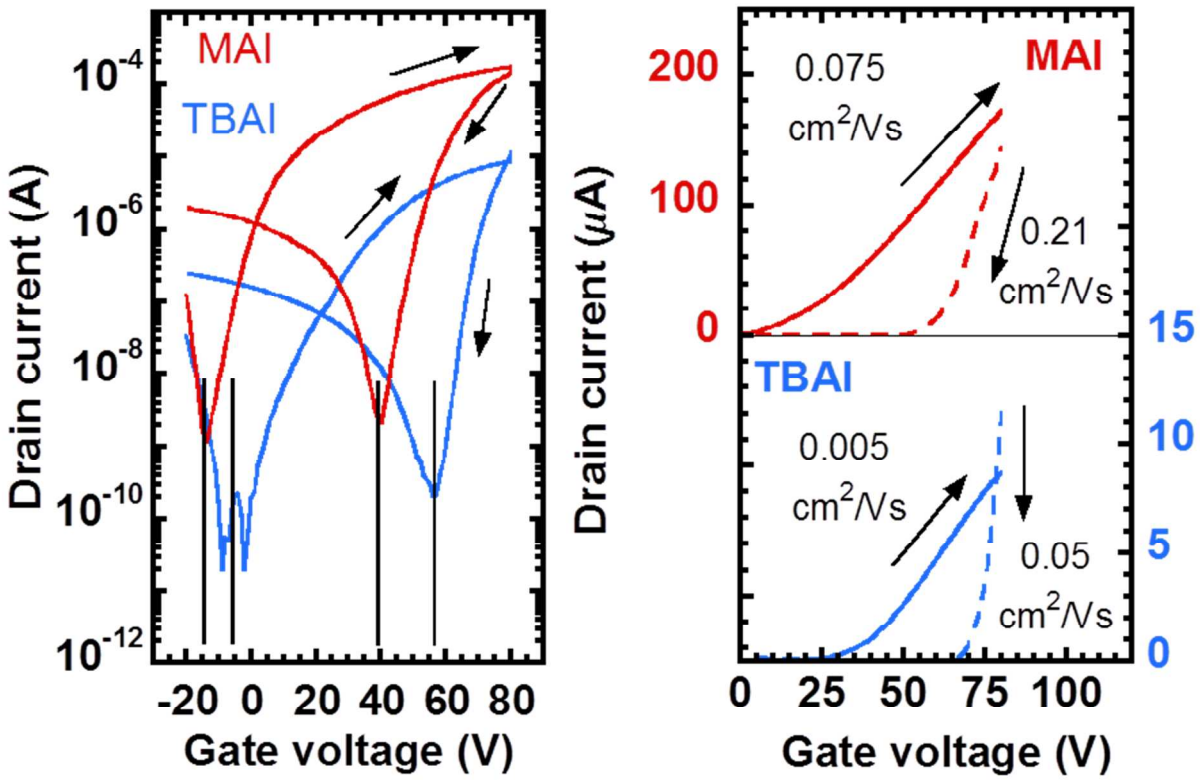

Figure S5. Off-state and mobility hysteresis of FETs prepared with MAI and TBAI reactants.

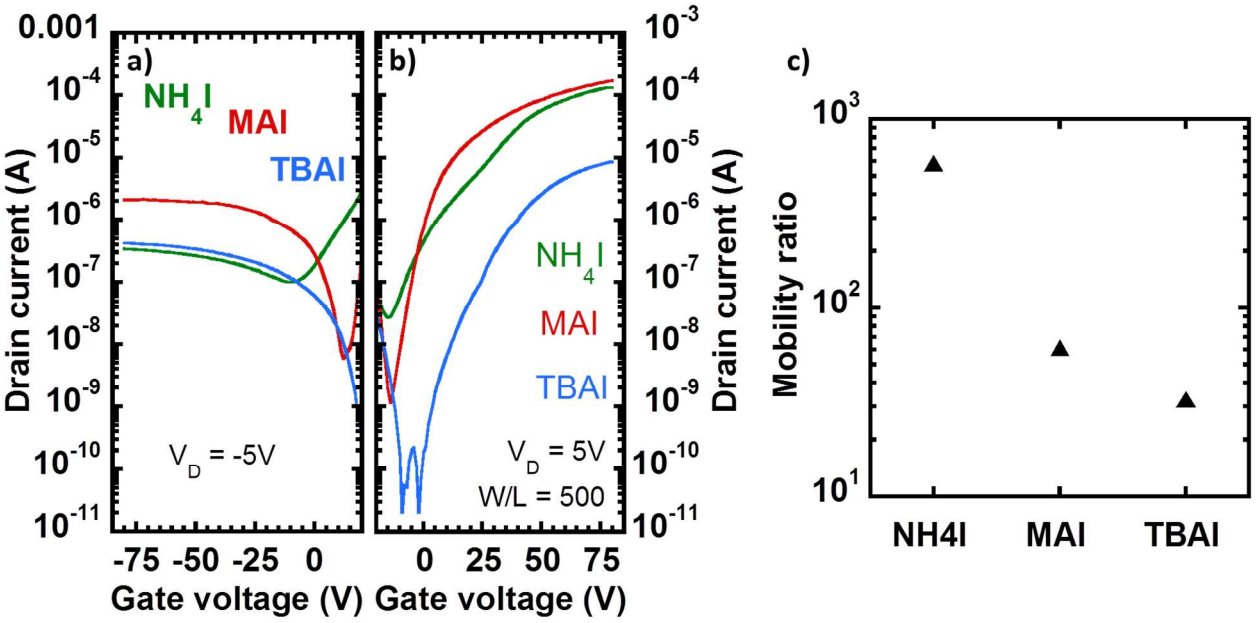

Figure S6. (a) p-channel and (b) n-channel transfer curves of FETs prepared with the three LE solutions and (c) the electron-hole mobility ratios.

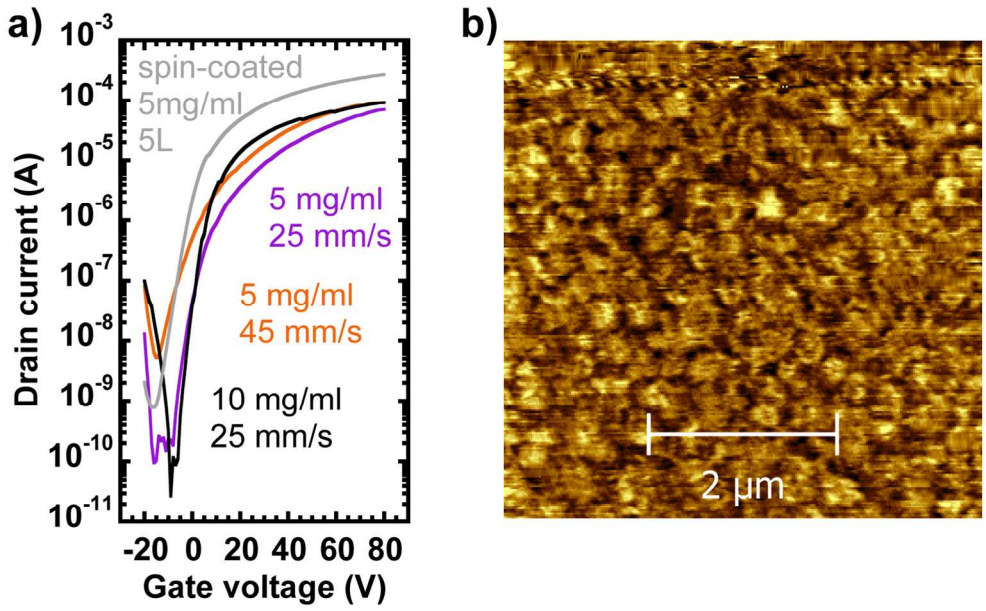

Figure S7 (a) Some curves from the optimization of the blade-coating speed and the used PbS CQD concentration for devices based on MAI exchange. The ~35 nm thickness of the LBL spin-coated sample is higher than any of the blade-coated ones, which may account for the higher current. (b) AFM image of the channel of an actual device; RMS = 2.2 nm

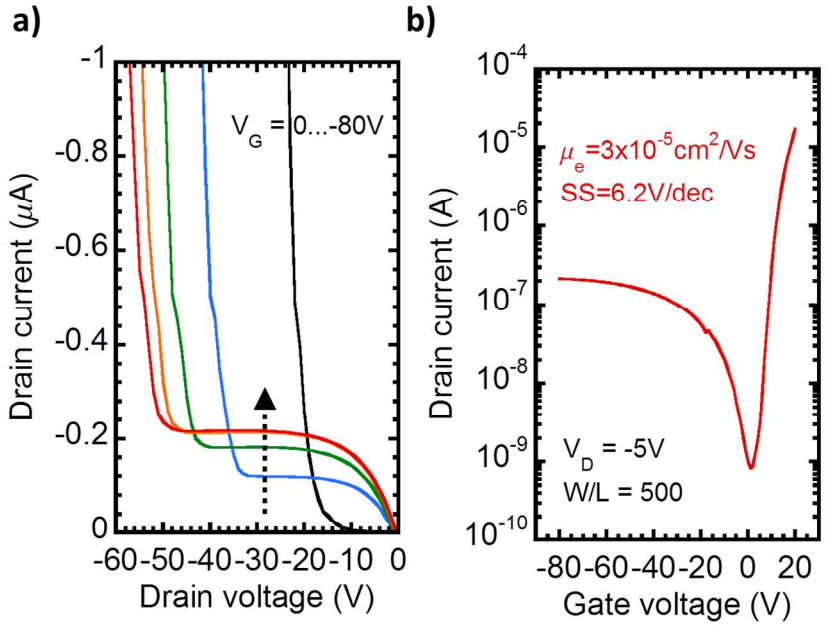

Figure S8. (a) I_D-V_D (output) and (b) p-channel I_D-V_G (transfer) curves measured in one of the champion FETs treated with MAI.

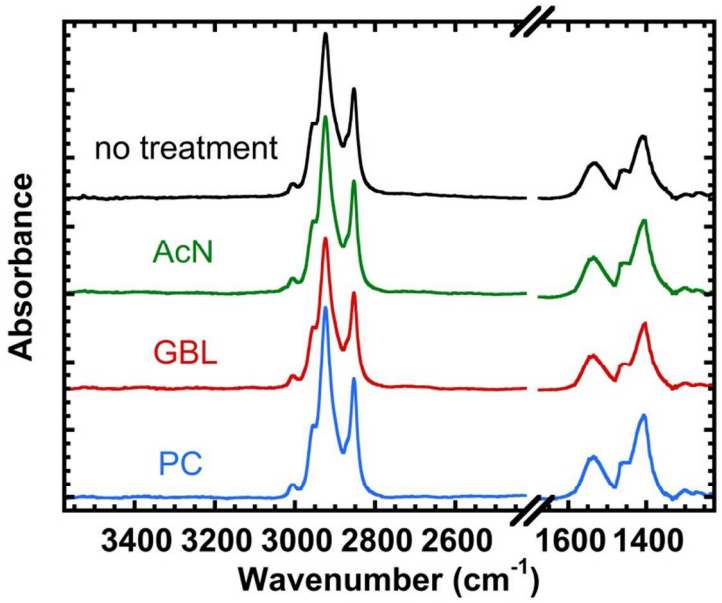

Figure S9. FTIR spectra of PbS-OA thin films after treatment with TBAI in different solvents (AcN: acetonitrile, PC: propylene carbonate, GBL: γ-butyrolactone). The absorbance peaks show very similar OA content.

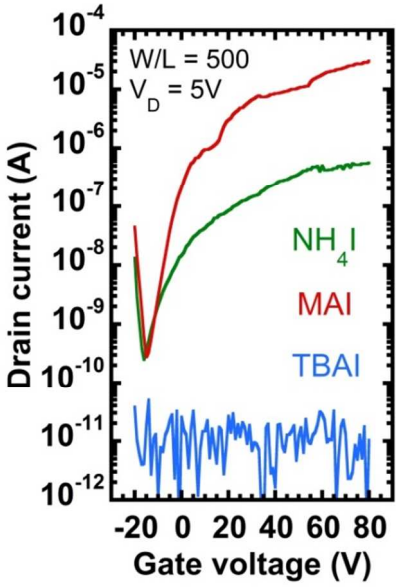

Figure S10. Transfer curves of FETs prepared using acetonitrile as solvent. While TBAI shown no sign of LE, MAI dissolved in acetonitrile readily reacts with the CQD film. The solubility of NH_4I in the solvent was so low that it suppressed the reactivity of the solution.

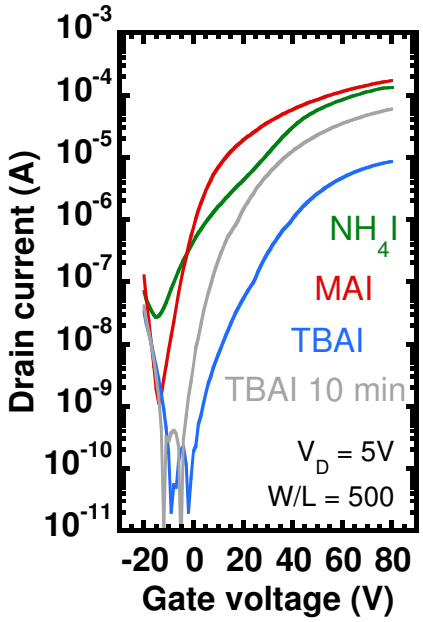

Figure S11. Effect of exposure time to TBAI/MeOH solution on the PbS CQDs FET transfer characteristics. The exposure time was 1 min in case of the coloured curves and 10 min for the grey curve.

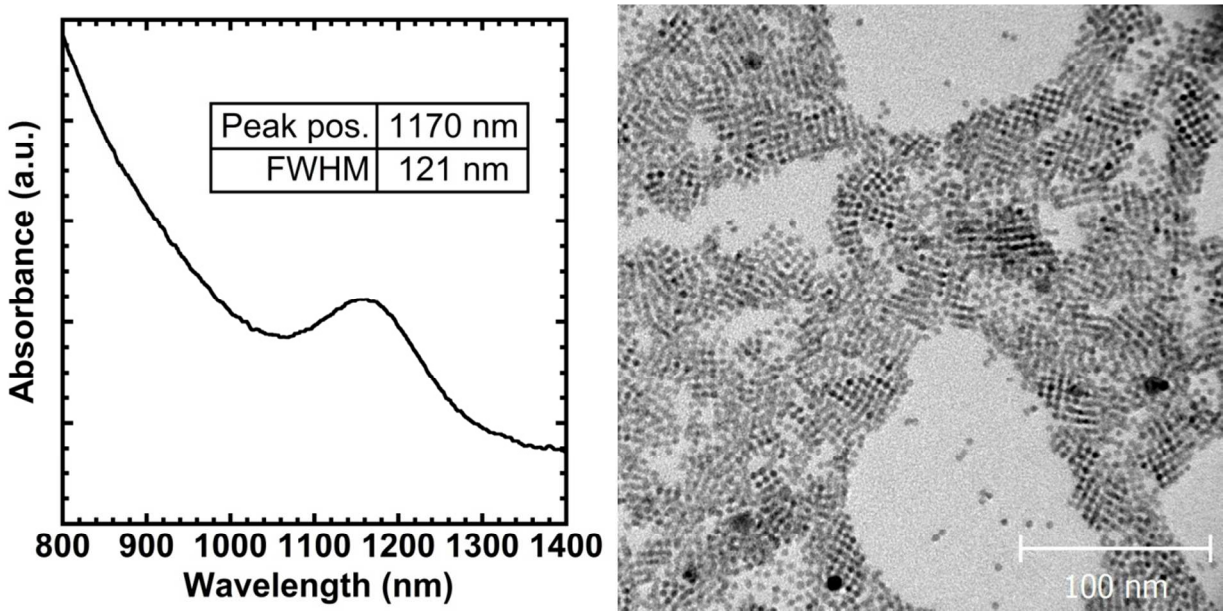

Figure S12. a) Visible and Near Infrared absorption spectrum of a film treated with MAI and annealed at 120°C; b) TEM image of PbS CQDs treated with NH_4I and annealed at 120°C.