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The effect of oxidation on charge carrier motion in PbS quantum dot thin films studied with Kelvin Probe Microscopy[1] LAN PHUONG NGUYEN HOANG, PHEONA WILLIAMS, JASON MOSCATELLO, KATHY AIDALA[2], Mt Holyoke Coll, AIDALA GROUP TEAM — We developed a technique that uses scanning probe microscopy (SPM) to study the real-time injection and extraction of charge carriers in thin film devices. We investigate the effects of oxidation on thin films of Lead Sulfide (PbS) quantum dots with tetrabutyl-ammonium-iodide (TBAI) ligands in an inverted field effect transistor geometry with gold electrodes. By positioning the SPM tip at an individual location and using Kelvin Probe Force Microscopy (KPFM) to measure the potential over time, we can record how the charge carriers respond to changing the backgate voltage with grounded source and drain electrodes. We see relatively fast screening for negative backgate voltages because holes are quickly injected into the PbS film. The screening is slower for positive gate voltages, because some of these holes are trapped and therefore less mobile. We probe these trapped holes by applying different gate voltages and recording the change in potential at the surface. There are mixed reports about the effect of air exposure on thin films of PbS quantum dots, with initial exposure appearing to be beneficial to device characteristics. We study the change in current, mobility, and charge injection and extraction as measured by KPFM over hours and days of exposure to air.

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