Improving the Efficiency and Stability of Perovskite Based Photodetectors by Using 2D/3D Perovskite Single Crystals

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In 2016, the World Economic Forum declared perovskites solar cells as one of the top ten emerging technologies in the world due to tremendous improvement in their efficiency and their economic value. However, perovskite materials need more improvement and investigation in terms of efficiency and stability. Three dimensional perovskites have shown great results in terms of efficiency. Yet, they have a key disadvantage of stability when exposed to the environment. Whereas two dimensional perovskites have a more stable performance. In this research, 2D/3D perovskite single crystals were grown to enhance stability and efficiency of fabricated photodetectors. Single crystals were used because they don't have grain boundaries that will result in reduction of the charge recombination and enhanced stability. Three different perovskite materials were fabricated including pure 3D MAPbI3, 2D/3D PAI: MAPbI3 and 2D/3D BAI: MAPbI3 on two different substrates, ITO and FTO. The single crystals, bulk and thin, were grown using the Inverse Temperature Crystallization technique. The morphology, absence of grain boundaries and the chemical composition were confirmed with multiple tests. Crystal resistance was measured without light, with room light and with mobile light. All perovskite single crystals showed significant resistance change for little light. However, the performance of the 3D material degraded very fast compared to the 2D/3D materials. The results suggest that 2D/3D perovskite single crystals maintained high stability and efficiency together. These photodetectors can potentially be used in different applications; such as, radiation detection, smoke detection, and to switch on relays for street lighting.

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