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Solution processable methylammonium-based transistors with different gate dielectric layers

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Abstract

Hybrid organic-inorganic perovskites has attracted much attention for its diverse optoelectronic applications. Many studies point out that hybrid organic-inorganic perovskites compounds have superior physical properties that can enable these materials to fabricate good performance solar cells. However, there is a lack of repeatable recipe for the fabrication of perovskite transistors with high mobilities. In this work, a detailed investigation has been conducted on the fabrication of Methylammonium-based perovskite compounds transistors on various polymer substrates. A group of methacrylate-based polymers has been chosen as the materials for gate dielectric layers. Generally, we found that the growth of perovskite crystals highly depends on the hydrophobicity of the substrates. More hydrophobic polymer layers yield larger crystal growth, but suppress the adhesion of perovskites crystals. Aromatic groups in methacrylate-based polymers have hydrophobic properties but it still gives better compact perovskite films with larger crystals. Poly(phenyl methacrylate) (PPhMA) enables the growth of the best perovskite films. The best performance of $MAPbI_{3-x}Cl_x$ perovskite transistors was fabricated on PPhMA with an electron mobility μ_{sat} = 4.30 $cm^2\ V^{-1}\ s^{-1}$ at 150 K. Photothermal deflection spectroscopy was used to investigate the subgap optical absorptions of the perovskite films.

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