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(54) **CONCURRENT CATIONIC AND ANIONIC METAL HALIDE PEROVSKITE DEFECT PASSIVATION METHOD AND DEVICE**

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(57) **ABSTRACT**

A semiconductor device includes a substrate, a first electrode located on the substrate, a metal halide perovskite layer located on the first electrode, a second electrode located on the metal halide perovskite layer, and passivation molecules that passivate the metal halide perovskite layer. The metal halide perovskite layer has (1) a top surface defect located in a top surface and (2) an inter-grain defect located at an interface between two adjacent grains, and the passivation molecules passivate at least one of the top surface defect and the inter-grain defect.