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Nanoscale Properties of Molecular Perovskite Solar Cells

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Molecular perovskites such as methyl ammonia metal halides are at the nexus of extensive research efforts worldwide trying to understand, improve, and apply their extraordinary photovoltaic properties. In less than 5 years since their first application in a solar cell, device efficiencies rose beyond 20comparable to decades-old conventional solar technologies including silicon and thin films (CdTe, CIGS, CZTS). The mechanisms for this high performance remain an active area of debate, but micro- and nano- scale structures including grain boundaries and possibly even ferroelectric domains are implicated as important features. Accordingly, we have employed Atomic Force Microscopy to characterize the local functional properties for MAPbI 3 . This includes the first direct observations of ferroelectric domains in molecular perovskites, as well as novel nanoscale mapping of conventional macroscopic PV performance metrics such as the short circuit current and open circuit voltage. Unique photoactivity is identified for individual grains, some (but not all) grain boundaries, and planar features that may be structural defects (e.g. twins) or ferroelastic or ferroelectric domains. Such insight into the nanoscale performance of materials is crucial to optimizing future technologies such as molecular perovskite solar cells.