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In-situ sputter deposition of Al electrodes on active layers of non-fullerene organic solar cells

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Organic solar cells (OSCs) have underwent significant improvements via both, novel organic synthesis and easy fabrication methods. However, the peeling-off of the top electrode fabricated by thermal evaporation (TA) leads to an intrinsic device degradation, which is one of the main reasons for the performance losses of OSCs. TA has the drawback of establishing only a soft contact between the electrode and the functional layer interface. Another disadvantage is the inevitable high temperature during the evaporation process, which can be harmful to organic materials and is energy extensive. To overcome these challenges, the magnetron sputtering technique appears very promising.
For understanding the mechanism of the metal cluster growth, we use in-situ GISAXS to observe the morphology changes during the sputtering process. In detail, the active layer of the organic solar cells is composed of the polymer donor PffDT4T-2OD and the small molecule accepter EH-IDTBR. Both were dissolved in 1,2,4-TMB and CB respectively to obtain different morphologies of the printed films. Then 10 nm MoO3 was deposited on their surface, which acts as the electron blocking layer for the invert solar cell device. A 20 nm Al layer is sputtered ontop as top electrode. Notably, the formation of the Al electrode on MoO3 is slower than on the active layer without deposition of MoO3. In addition, GISAXS, SEM and AFM measurements indicate that the morphology impact on the Al growth significantly.

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