TOF-SIMS investigation of degradation pathways occurring in a variety of organic photovoltaic devices – the ISOS-3 inter-laboratory collaboration

The present work is the fourth (and final) contribution to an inter-laboratory collaboration that was planned at the 3rd International Summit on Organic Photovoltaic Stability (ISOS-3). The collaboration involved six laboratories capable of producing seven distinct sets of OPV devices that were degraded under well-defined conditions in accordance with the ISOS-3 protocols. The degradation experiments lasted up to 1830 hours and involved more than 300 cells on more than 100 devices. The devices were analyzed and characterized at different points of their lifetimes by a large number of non-destructive and destructive techniques in order to identify specific degradation mechanisms responsible for the deterioration of the photovoltaic response. Work presented herein involves time-of-flight secondary ion mass spectrometry (TOF-SIMS) in order to study chemical degradation in-plane as well as in-depth in the organic solar cells. Various degradation mechanisms were investigated and correlated with cell performance. For example, photo-oxidation of the active material was quantitatively studied as a function of cell performance. The large variety of cell architectures used (some with and some without encapsulation) enabled valuable comparisons and important conclusions to be drawn on degradation behaviour. This comprehensive investigation of OPV stability has significantly advanced the understanding of degradation behaviour in OPV devices, which is an important step towards large scale application of organic solar cells.

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