Improving OPV Active Layer Photostability with Perfluoroalkyl Fullerenes (PV-2)

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Scientific Achievement:

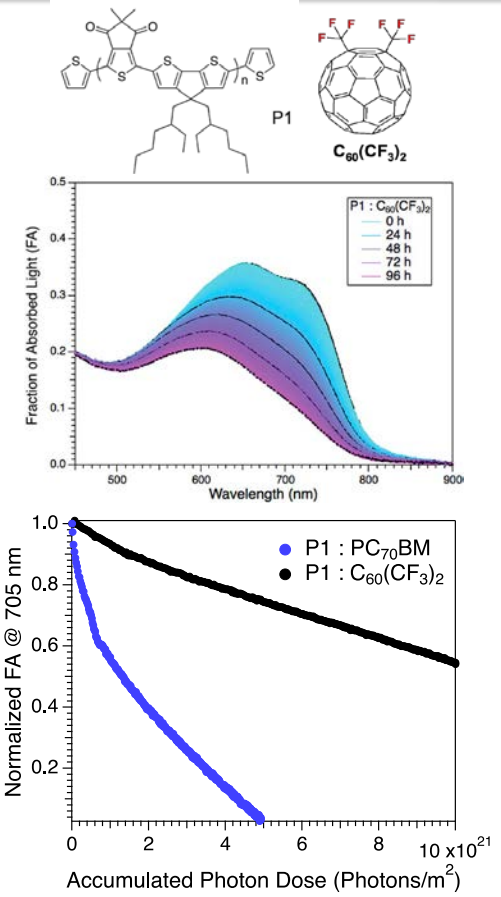
A perfluoroalkyl fullerene stabilized the photobleaching rate of two organic donor molecules by a factor of 15 over blends with a traditional fullerene in unencapsulated thin films.

Significance and Impact:

This study provides guidance for designing organic photovoltaic (OPV) active-layer components with improved intrinsic stability, which will ultimately help improve the industrial viability of this technology.

Research Details:

- Photobleaching dynamics of two organic donors studied under white-light illumination in air with blends of $PC_{70}BM$ and $C_{60}(CF_3)_2$ at NREL.
- IISc student correlated changes in bleaching rates during the experiment with changes in morphology using photoluminescence quenching measurements.
- Design rules (in terms of fullerene electron affinity and miscibility of the donor-acceptor components) were developed for successfully using $C_{60}(CF_3)_2$ to stabilize OPV donor materials.



(**Top**): >575 spectra of unencapsulated P1:$C_{60}(CF_3)_2$ auto-recorded over 96 h during continuous illumination. (**Bottom**): Photobleaching kinetics reveal how $C_{60}(CF_3)_2$ stabilizes the blend relative to $PC_{70}BM$.

Publication: L.E. Garner, V. Nellissery Viswanathan, D.H. Arias, C.P. Brook, S.T. Christensen, A.J. Ferguson, N. Kopidakis, B.W. Larson, Z.R. Owczarczyk, J.R. Pfeilsticker, P.C. Ramamurthy, S.H. Strauss, O.V. Boltalina, W.A. Braunecker, Photobleaching Dynamics in Small Molecule vs. Polymer Organic Photovoltaic Blends with 1,7-Bis-Trifluoromethylfullerene, *J. Mater. Chem. A.* **6**, 4623–4628 (2018).

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