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Self-assembly and Photo-patterning in Polymer-fullerene Nanocomposite Thin Films HIM CHENG WONG, Imperial College London, ANTHONY HIGGINS, Swansea University, ANDREW WILDES, Institut Laue-Langevin, JACK DOUGLAS, The National Institute of Standards and Technology, JOAO CABRAL, Imperial College London — We report the directed self assembly of fullerenes in polymer thin films. The fullerenes are found to assemble spontaneously into spinodally coordinated clusters upon thermal annealing. The process yields well-defined structures, ranging from sparse heterogeneous nucleation to dense spinodal-like morphologies with tuneable characteristic spatial frequency and amplitude which coarsen with time, following well-defined scaling laws [1]. Mapping of this self assembly process utilized both real and reciprocal space techniques: optical and scanning force microscopy and neutron reflectivity. With external fields: light exposure and substrate surface energy, we demonstrate further tuneability over nanocomposite thin film morphology and substantial improvement on ultrathin film stability. By modulating the external fields on nanocomposite film with photomask, followed by thermal annealing, the film morphology and stability can be directed into various patterns, including a prototype polymer-fullerene circuit [2]. These results provide insights into fullerene self assembly in polymers and underscore their photoactive nature, an effect of great interest in the performance and stability of organic photovoltaics (OPV). [1] Wong H C and Cabral J T 2010 Phys. Rev. Lett. 105 038301 and 2011 Macromolecules 44 4530. [2] Wong H C, Higgins A M, Wildes A, Douglas J F, Cabral J T 2012 Adv. Mater. In Press.

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