Effect of Copolymer Chain Architecture on Active Layer Morphology and Device Performance JOJO AMONOO, ANTON LI, MATTHEW SYKES, BINGYUAN HUANG, EDMUND PALERMO, ANNE MCNEIL, MAX SHTEIN, PETER GREEN, University of Michigan — The optimum morphological structure that determines the device performance of bulk heterojunction thin film polymer solar cells is greatly influenced by the extent of phase separation between the polymer and fullerene components, which ultimately defines the length scales and purity of the donor- and acceptor-rich phases. Block copolymer thin films have been widely studied for their ability to microphase separate into well-defined nanostructures. Nickel-catalyzed chain-growth copolymerizations of thiophene and selenophene derivatives afforded well-defined π-conjugated copolymers of poly(3-hexylthiophene) (P3HT) and poly(3-hexylselenophene) (P3HS) to achieve diblock, random and gradient copolymer chain architectures. This allowed us to study the effect of copolymer sequence and nanoscale morphology of P3HT-P3HS copolymer/[6,6]-phenyl-C61-butyric acid methyl ester ($PC_{61}BM$) on device performance. With the use of energy-filtered transmission electron microscopy and conductive and photoconductive atomic force microscopy we found that copolymer sequence strongly influences the phase separation capabilities of the copolymer-fullerene blend in bulk heterojunction organic photovoltaic devices.

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