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Vertical phase-separation due to differences in surface energies in bulk heterojunction polymer solar cells SARAH COWAN, ANSHUMAN ROY, JI SUN MOON, SUNG HEUM PARK, ALAN HEEGER, University of California - Santa Barbara — The synthesis and testing of new photoactive polymers is steadily improving the light conversion efficiencies of organic bulk heterojunction solar cells. Understanding the physical interactions between the polymer donor material and the electron acceptor is critical in controlling and optimizing the morphology of the blend. While interactions between the donor and acceptor in the blend determine the scale and stability of lateral phase separation, interactions between the constituents of the blend and the neighboring device layers are equally important. In this work, we demonstrate that bulk heterojunction constituents in a polymer solar cell tend to vertically phase-separate due to differences in surface energies leading to surface-directed spinodal decomposition and/or a wetting layer. Using a combination of cross-sectional transmission electron microscopy (TEM), variable angle spectroscopic ellipsometry (VASE), and a contact angle study, we probe the vertical phase separation in poly(3-hexylthiophene) : [6,6]-phenyl-C61-butyric acid methyl ester (P3HT:PCBM) and poly[N-9′-heptadecanyl-2,7-carbazole-alt-5,5-(4′,7′-di-2-thienyl-2′,1′,3′-benzothiadiazole)] : [6,6]-phenyl-C71-butyric acid methyl ester (PCDTBT:PC70BM).

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