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X-ray scattering Study of Ordering in Liquid Crystalline Semiconducting Polymers MICHAEL CHABINYC, Palo Alto Research Center, MICHAEL TONEY, Stanford Synchrotron Research Laboratory, IAIN MCCULLOCH, Imperial College, MARTIN HEENEY, Queen Mary University of London
— The electrical performance of thin-film transistors, TFTs, formed with semiconducting polymers is approaching that of amorphous silicon. The highest performance TFTs are obtained from semiconducting polymers with liquid crystalline (LC) mesophases. Thermal annealing of these materials after deposition can increase the field effect mobility by as much as an order of magnitude. We will report the results of detailed x-ray scattering studies of the impact of thermal annealing on the crystalline ordering in thin films of poly(2,5-bis(3-n-alkyl-2yl)thieno[3,2-b]thiophene), PBTTT. The packing structure of this polymer has a lamellar stacking direction due to the alkyl sidechains and a π-stacking direction due to the planar backbones. Measurements of the lamellar d-spacing show that the lamellar packing in the as-cast state is distinct from the packing in annealed films. The change in ordering occurs after the film is heated into the LC mesophase. The LC mesophase is highly ordered with maintenance of both the lamellar and π-stacking of the polymer chains. The largest differences in these phases are found in the ordering of the sidechains with smaller changes in the π-stacking. The influence of these phases on electrical transport will be discussed.

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