Electronic Supplementary Material (ESI) for Materials Advances.

Supporting Information

High Performance As-cast P3HT:PCBM Devices: Understanding the Role of Molecular Weight in High Regioregularity P3HT.

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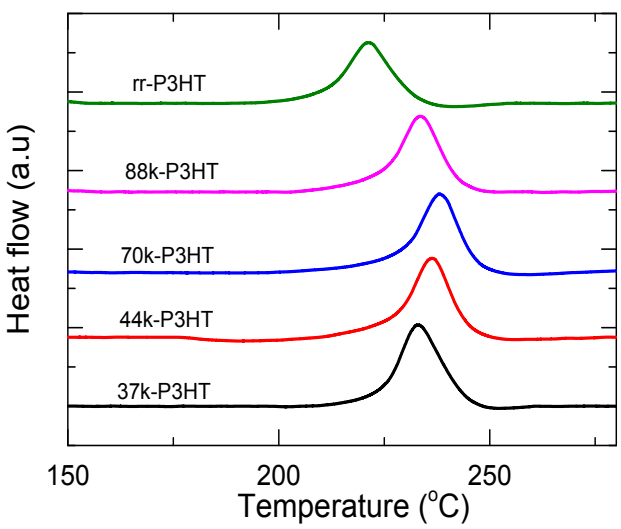

Figure S1: Second heating heat-flow curves of the different pristine P3HT samples obtained from DSC measurement.

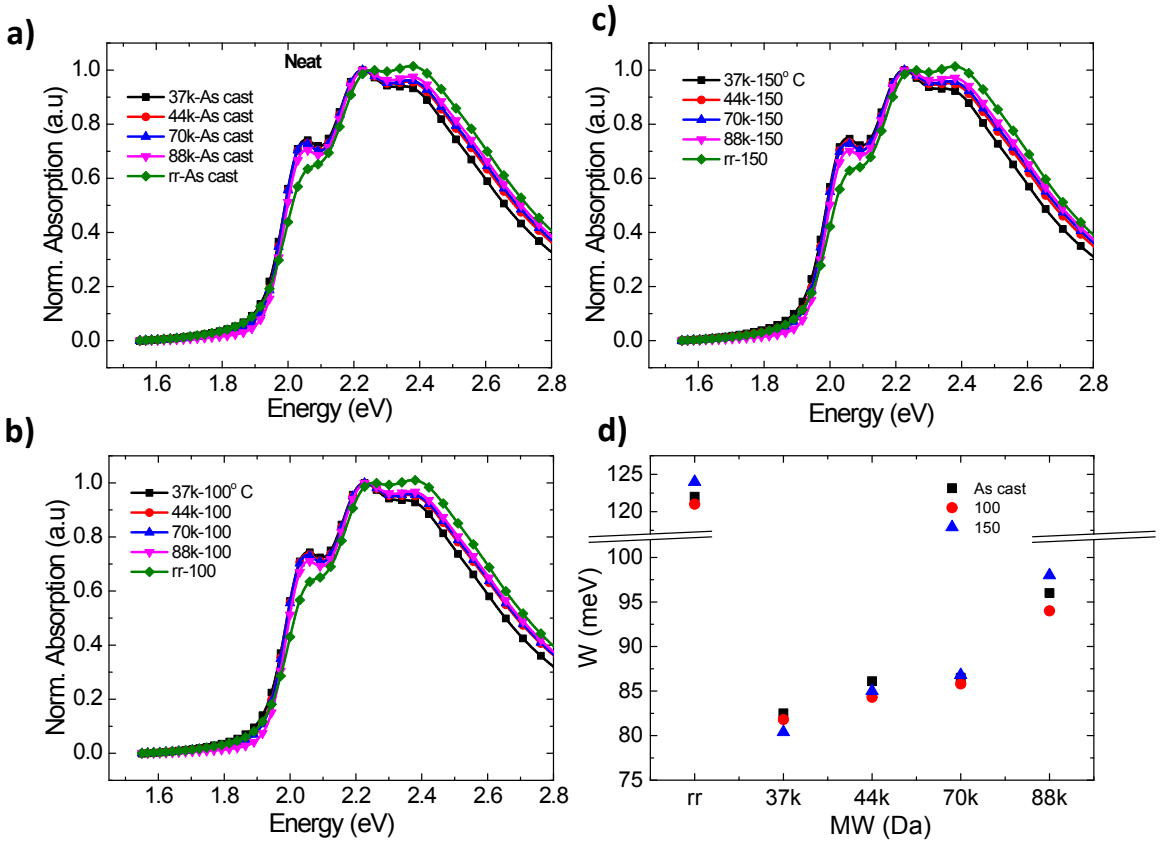

Figure S2: Normalized UV-Vis absorption spectrum at 0-1 peak of pristine P3HT polymers over glass substrate a) as-cast, b) 100 °C for 10 min and c) 150 °C for 10 min and d) represents the value of *W* with respect to different MW.

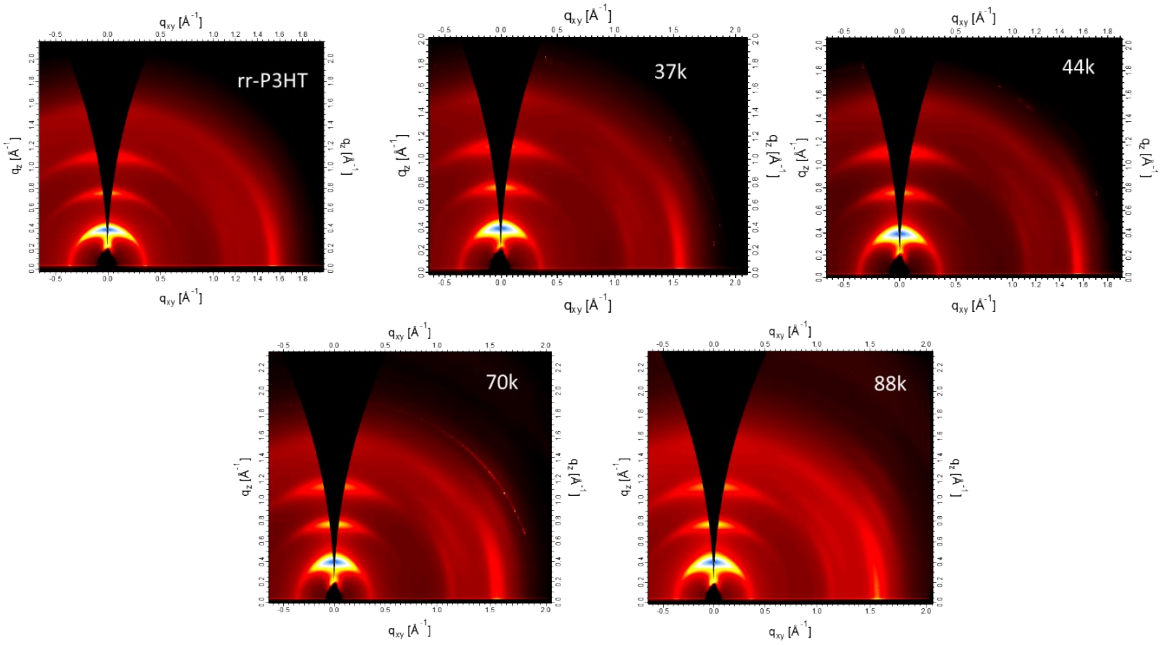

Figure S3: Two-dimensional GIWAXS image of as-cast pristine-P3HT films.

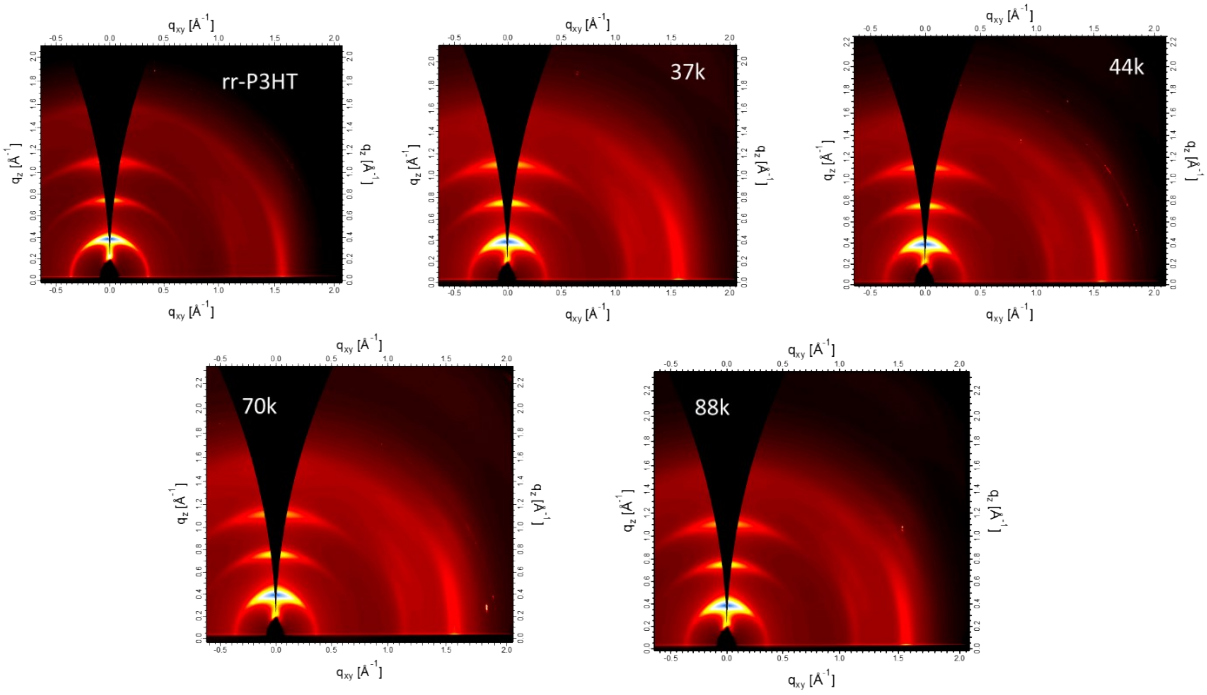

Figure S4: Two-dimensional GIWAXS image of pristine-P3HT films annealed at 150 ^{o}C for 10 min.

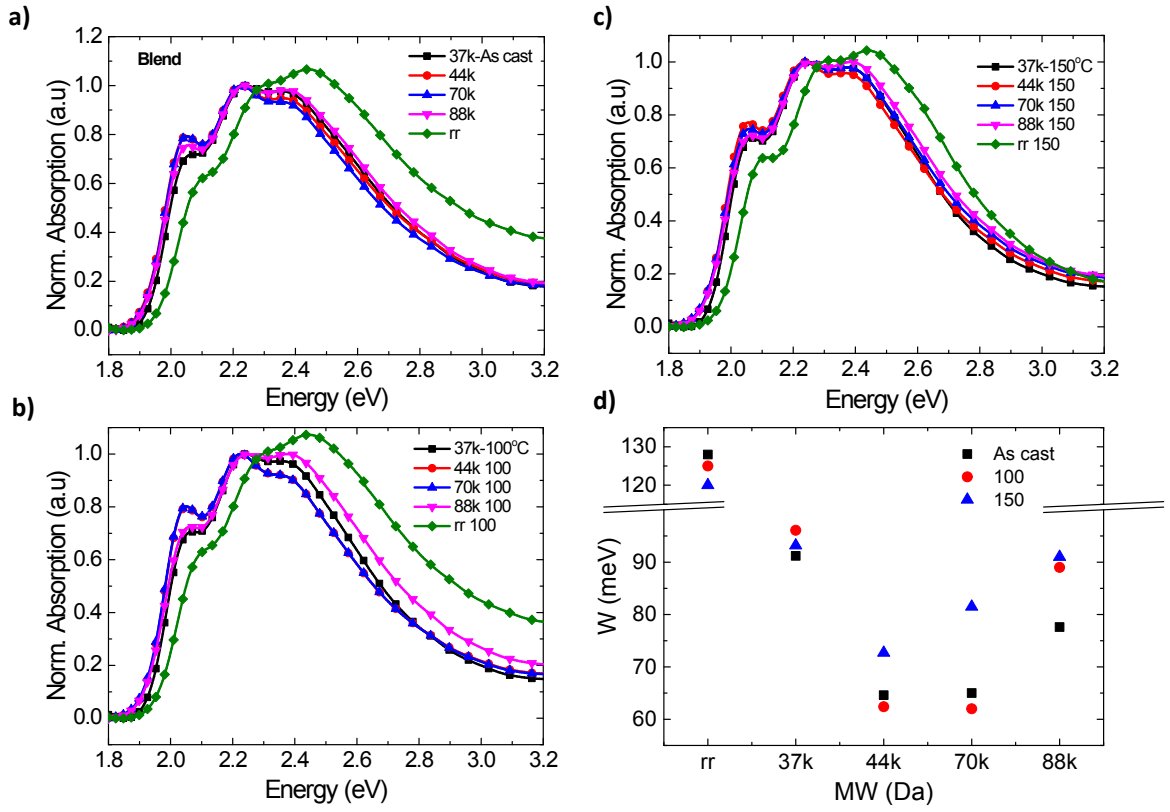

Figure S5: Normalized (0-1 peak) UV-Vis absorption spectrum of P3HT:PCBM blends over glass substrate a) as-cast, b) 100 °C, c) 150 °C, and d) represents the value of *W* with respect to different MW.

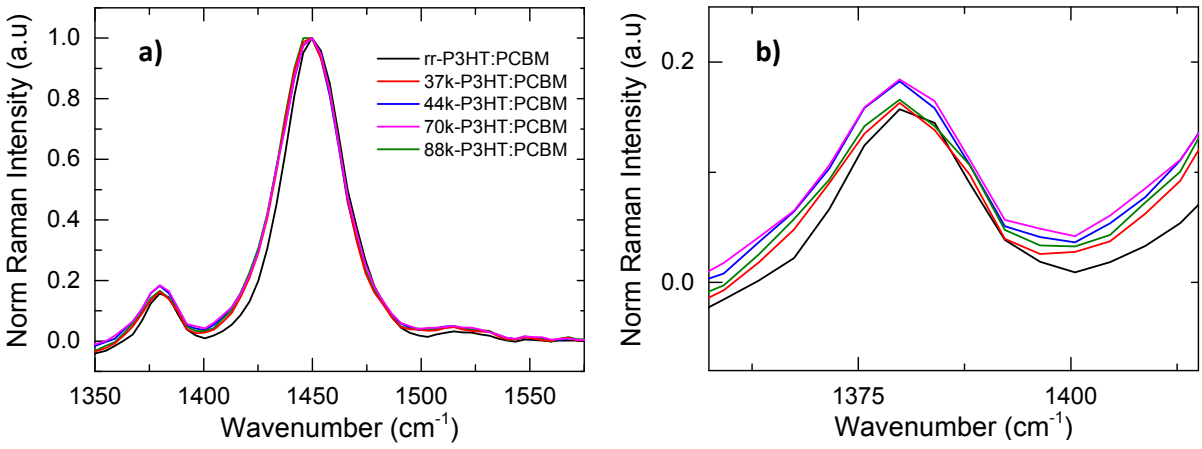

Figure S6: Resonant Raman spectra of different as-cast P3HT:PCBM polymer blends with 532 nm wavelength excitation. a) Raman spectra normalized with C=C stretching peak maximum intensity. b) Zoomed plot of normalized Raman spectra highlighting the height of C-C intra-ring stretching Raman mode

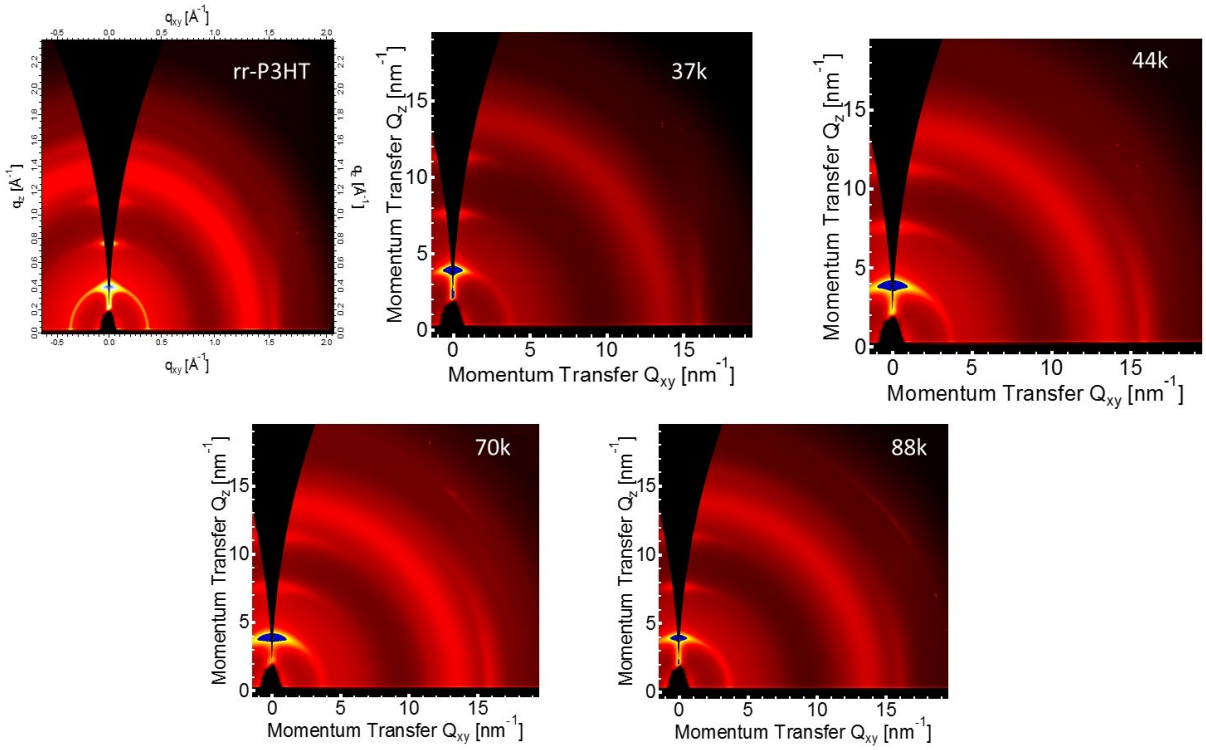

Figure S7: Two-dimensional GIWAXS image of as-cast P3HT:PCBM blend films.

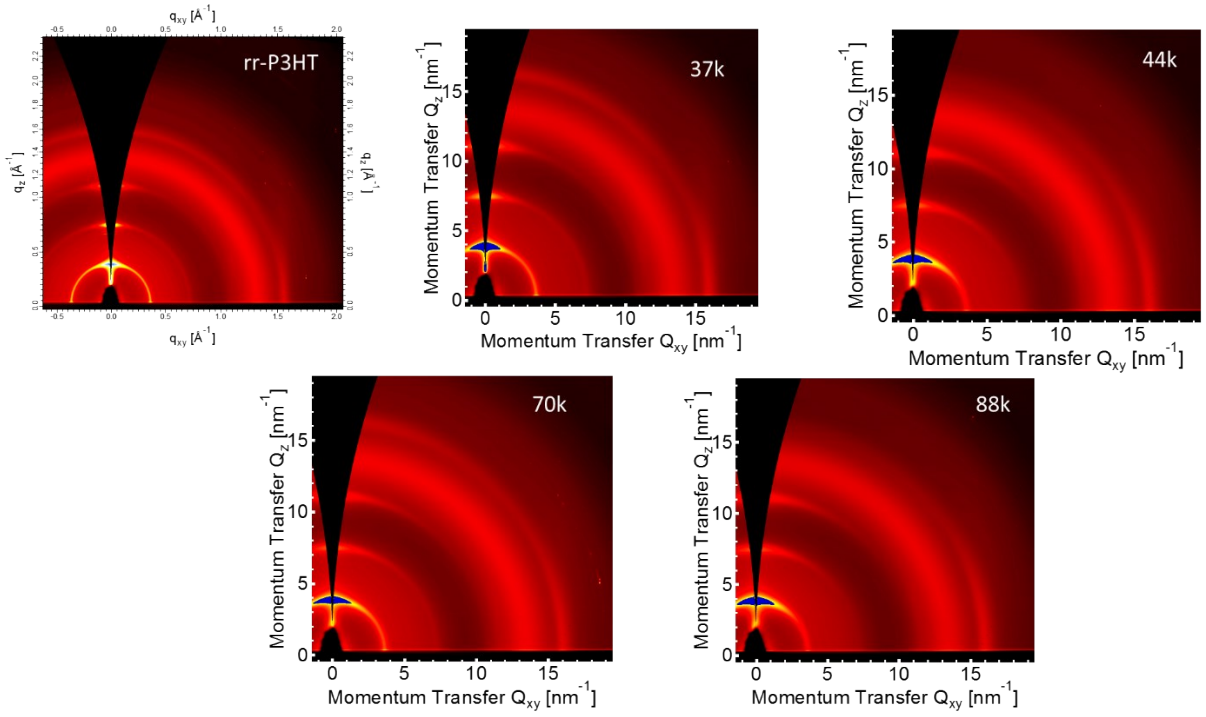

Figure S8: Two-dimensional GIWAXS image of P3HT:PCBM blend films annealed at 150 °C for 10 min.

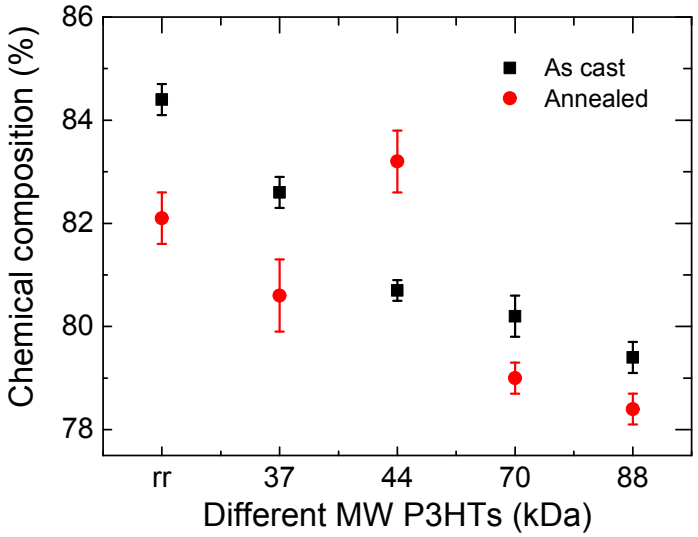

Figure S9: Surface chemical composition of P3HT on the top surface of the P3HT:PCBM blends extracted from the NEXFAS spectra.

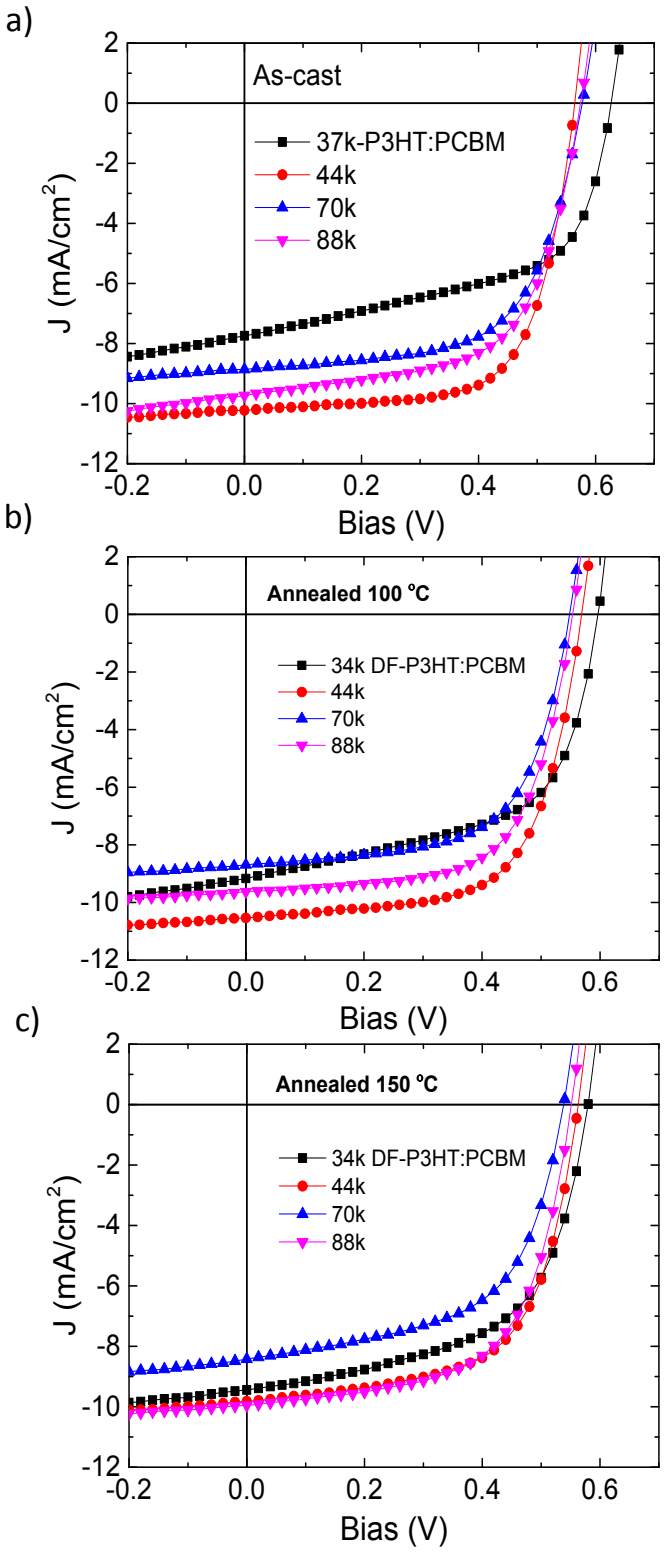

Figure S10: Light illuminated J-V characteristics of different P3HT:PCBM solar cells with different annealing conditions a) as-cast; b) thermal annealed at 100 °C for ten minutes, and c) thermal annealed at 150 °C for ten minutes.

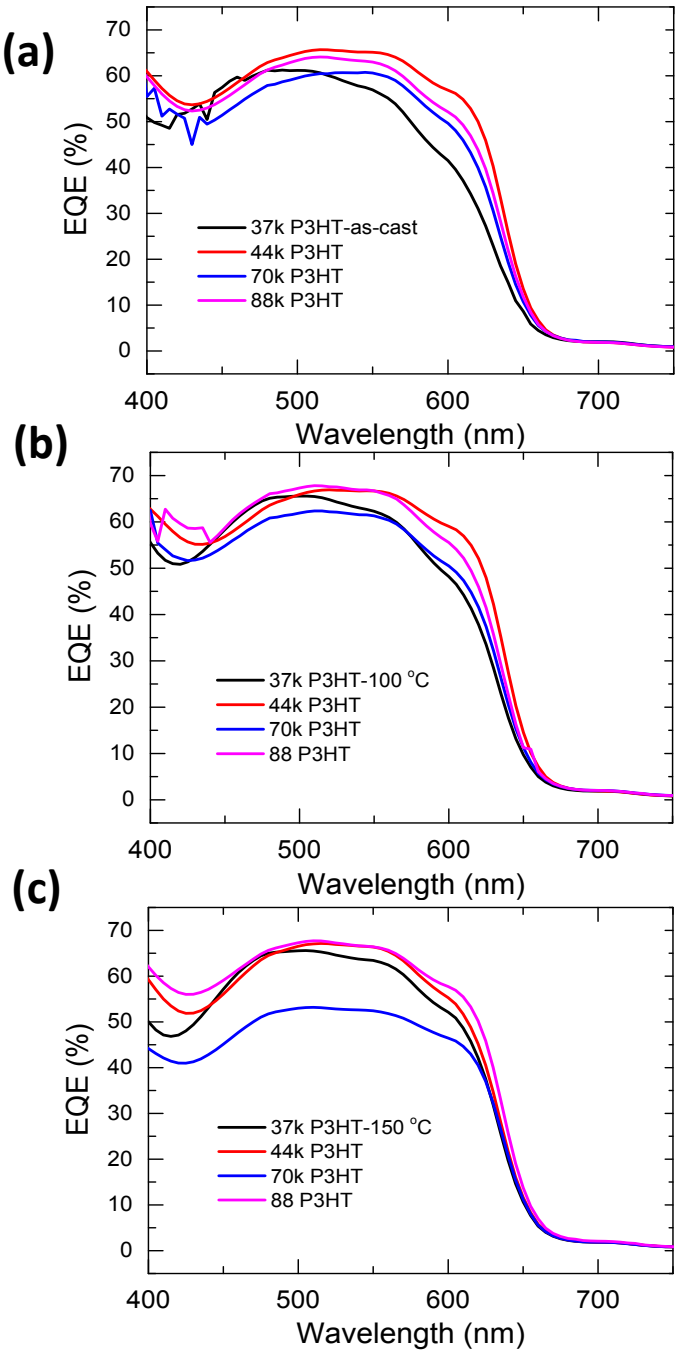

Figure S11: External quantum efficiency (EQE) plots of different MW P3HT at **a)** as-cast **b)** 100 °C and **c)** 150 °C.