Supporting Information

Effect of Alkyl Side Chain Length on Intra and Inter-molecular Interactions of Terthiophene-Isoindigo Copolymers

Newayemedhin A.Tegegne[1,2], Zelalem Abdissa[3], Wendimagegn Mammo[3], Takayuki Uchiyama[4], Yoshiko Okada-Shudo[4], Francesco Galeotti[5], William Porzio[5], Mats R. Andersson[6], Derck Schlettwein[7], Varun Vohra[4] and Heinrich Schwoerer[8]

[1] Department of Physics, Addis Ababa University, P.O.Box 1176, Addis Ababa, Ethiopia, [2]Laser Research Institute, Physics Department, Stellenbosch University, South Africa, [3]Department of Chemistry, Science Faculty, Addis Ababa University, P.O.Box 33658, Addis Ababa, Ethiopia., [4]Department of Engineering Science, University of Electro-Communications, Chofugaoka 1-5-1, 182-8585 Chofu (Tokyo), Japan , [5] Istituto di Scienze e Tecnologie Chimiche "G. Natta"-Consiglio Nazionale delle Ricerche (SCITEC-CNR) Via A. Corti, 12, 20133 Milano Italy, [6]Future Industries Institute, University of South Australia, Mawson Lakes Boulevard, Mawson Lakes SA 5095, [7]Institut fur Angewandte Physik , Justus-Liebig-University, Heinrich Bu Ring 16, 35392, Giessen, Germany, [8] Max Planck Institute for the Structure and Dynamics of Matter, Luruper Chaussee 149, 22761 Hamburg, Germany.

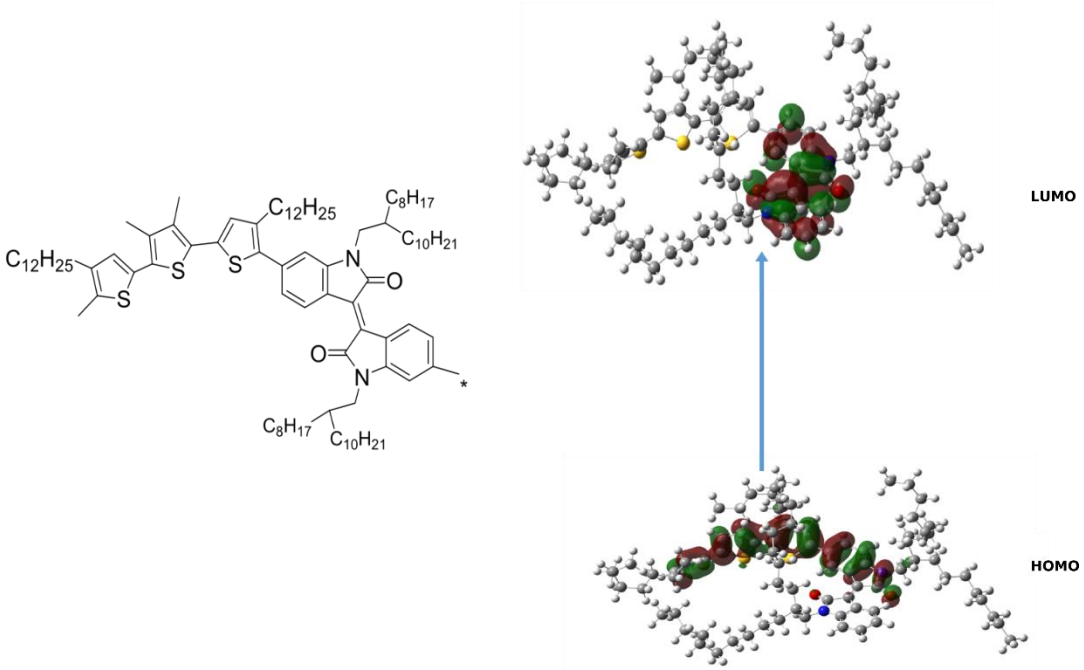

Figure S1: Electronic structure of **P3TI-D** as calculated by DFT using Gaussian 09 software with B3LYP function and 6-31G basis set. The charge distribution in the highest occupied molecular orbital (HOMO) covers the backbone of the copolymer. Upon excitation the electron distribution is essentially located in the isoindigo (acceptor) unit while the hole is localized in the acceptor (terthiophene) unit of the copolymer. This is due to intramolecular charge transfer within the copolymer unit.

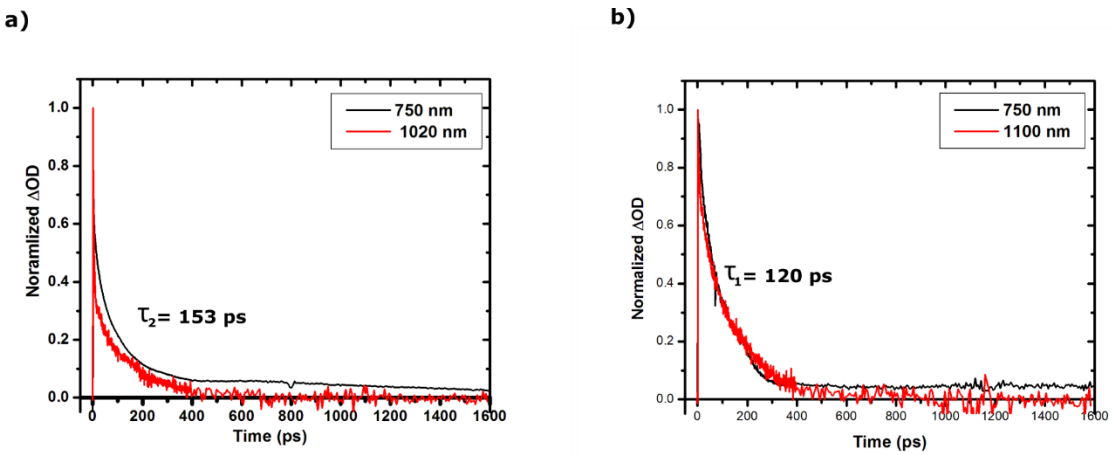

Figure S2: The excited state absorption (ESA) temporal profiles taken at different wavelength show life times of a) 153 ps in **P3TI-O** and b) 120 ps in **P3TI-D.** The similar temporal profiles of the ESA in each copolymer films show that exciton is the only excited state species in the copolymer films unlike the copolymers in solution.

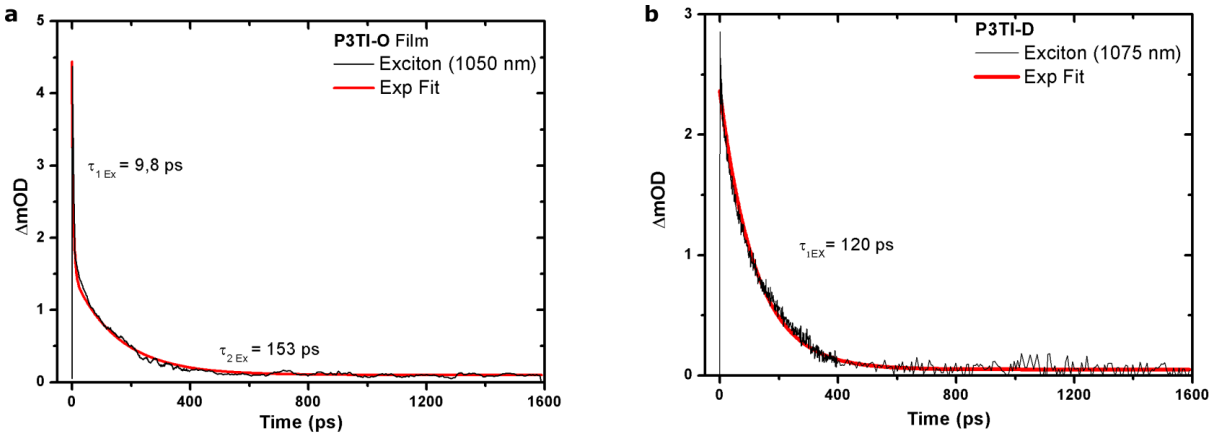

Figure S3: Temporal profile and fitting of exciton dynamics in a) **P3TI-O** and b) **P3TI-D**. The exciton relaxes faster in the longer side chain copolymer (**P3TI-D**)

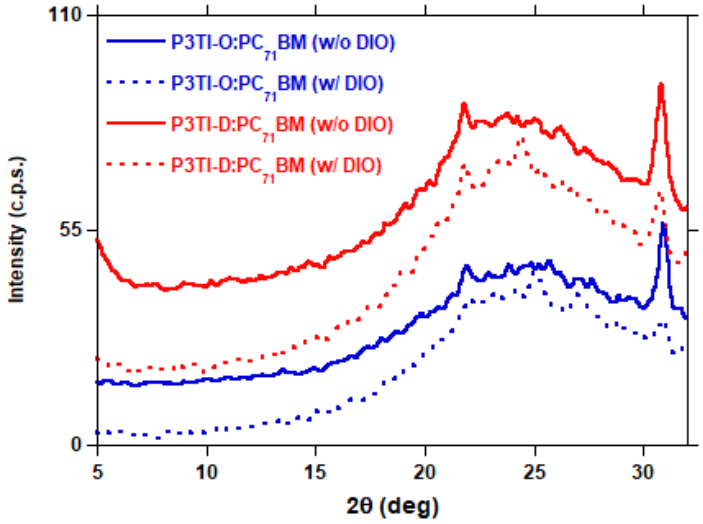

Figure S4: XRD patterns of **P3TI-O**:$PC_{71}BM$ (blue) and **P3TI-D**:$PC_{71}BM$ (red) films without (w/o) DIO (full lines) and with (w/) DIO (dotted lines).

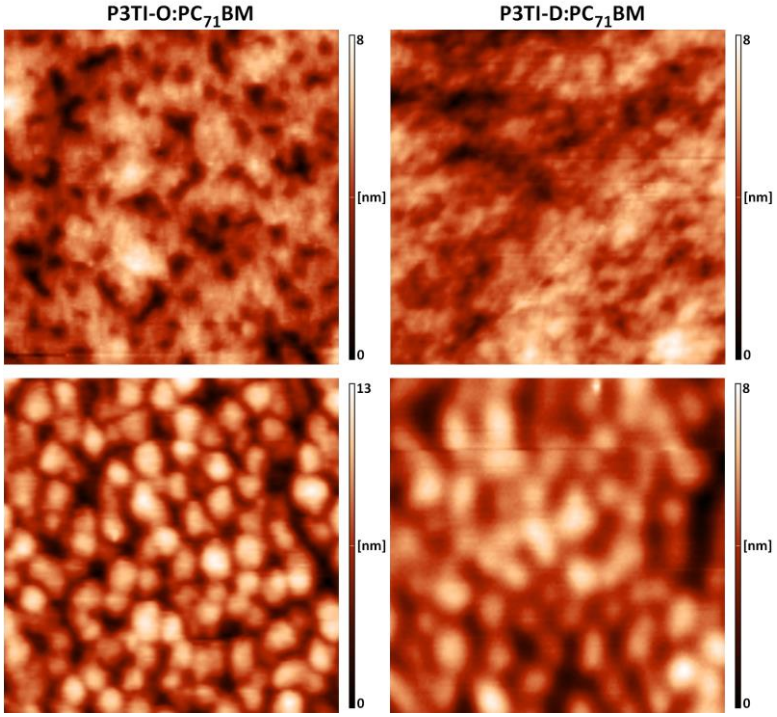

Figure S5: AFM images (2.5 X 2.5 μm^2) of **P3TI-O**:$PC_{71}BM$ and **P3TI-D**:$PC_{71}BM$ active layers deposited from DCB only (top) and DCB with DIO (bottom).

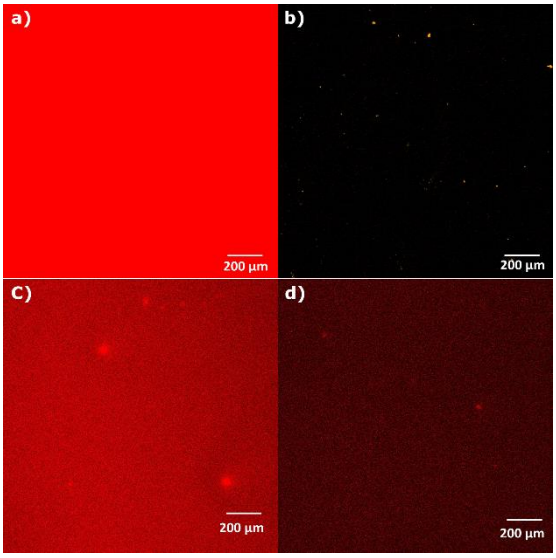

Figure S6: Fluorescence (FL) images of (a) Pristine **P3TI-O** film (average FL = 58.9 counts/3 mm^2 in 10^6 pixels) (b) **P3TI-O**:$PC_{71}BM$ BHJ Film (average FL = 5.4 counts/3 mm^2 in 10^6 pixels). (c) Pristine **P3TI-D** film (average FL = 7.5 counts/3 mm^2 in 10^6 pixels) (d) **P3TI-D**:$PC_{71}BM$ BHJ Film (average FL = 39.5 counts/3 mm^2 10^6 pixels). The redder images show higher FL while the darker images represent reduced FL. Exciton quenching was calculated after normalizing each film to the absorption of pristine copolymers. The quenching is more efficient in **P3TI-O**:$PC_{71}BM$ based film.