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Optical Characterization of Anisotropic Thiophene-Phenylene Co-Oligomer Micro Crystals by Spectroscopic Imaging Ellipsometry

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Abstract : Here we demonstrate a non-destructive optical technique to localize and characterize single crystals of semiconductive organic materials – Spectroscopic Imaging Ellipsometry. With a combination of microscopy and ellipsometry, it is possible to characterize even micro-sized thin film crystals on plane surface regarding anisotropy, optical properties, crystalline domains and thickness. The semiconducting thiophene-phenylene co-oligomer 1,4-bis(5'-hexyl-[2,2'-bithiophen]-5-yl)benzene (dHex-TTPTT) crystals were grown by solvent based self-assembly technique on silicon substrate with 300 nm thermally silicon dioxide. The ellipsometric measurements were performed with an Ep4-SE (Accurion). In an ellipsometric high-contrast image of the complete sample, we have localized high-quality single crystals. After demonstrating the uniaxial anisotropy of the crystal by using Müller-Matrix imaging ellipsometry, we determined the optical axes by rotating the sample and performed spectroscopic measurements (λ = 400-700 nm) in 5 nm intervals. The optical properties were described by using a Lorentz term in the Ep4-Model. After determining the dispersion of the crystals, we converted a recorded Delta and Psi-map into a 2D thickness image. Based on a quantitative analysis of the resulting thickness map, we have calculated the height of a molecular layer (3.49 nm).

Keywords : anisotropy, ellipsometry, SCFET, thin film
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