Imaging Mueller-Matrix Ellipsometry of Anisotropic Thin-Film Semiconductors

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Imaging Mueller-Matrix Ellipsometry (IMME) extends the powerful technique of Mueller-Matrix measurements into the world of microstructured samples, reaching lateral resolutions that are beyond the limits of conventional non-imaging ellipsometers. Here, we present applications of IMME for the quantitative optical analysis of microstructured anisotropic thin-film layers of semiconducting materials.

Few-layer black phosphorus features exceptional anisotropic optical and electronic properties making it an interesting option for research on 2D-semiconductors for electronic devices [1, 2]. We carried out optical measurements of the orientations and the optical dispersion of the in-plane principal axes of microscopic, mechanically exfoliated flakes of black phosphorus by means of IMME.

Thin-film crystallites of the semiconducting organic material Thiophene-phenylene were grown by a solvent-based self-assembly technique on a silicon substrate. Ellipsometric contrast micrographs revealed a vast variety of different domains on the examined sample that correspond to different layer thicknesses forming a terracelike structure (Fig.1). Rotational IMME scans of the sample yielded the in-plane orientation of the crystallites' optical axes. Combined with spectroscopic measurements, the dispersion function of Thiophene-phenylene and the terraces' layer thicknesses were obtained.

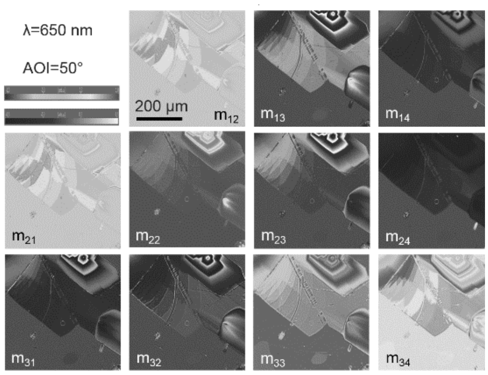

Fig. 1. 3x4-Mueller-Matrix micrographs of Thiophene-phenylene crystallites

Keywords: Mueller Matrix; Imaging Ellipsometry; 2D materials; organic semiconductors; anisotropy

References

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