Current Trends in Microscopic Characterization of 2D Materials with Spectroscopic Imaging Ellipsometry (SIE)

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Current developments in the field of 2D-Materials are focused on several areas. These areas include: microscopic devices based on stacking different 2D-materials into hybrid-structures, discovering new material configurations by exfoliating unconventional layered materials, optimizing CVD processes by minimizing crystallite boarders or using ideal shaped microcrystals as the starting point of a growth process and many more. These developments have in common that they require microscopic non-destructive characterization technologies.

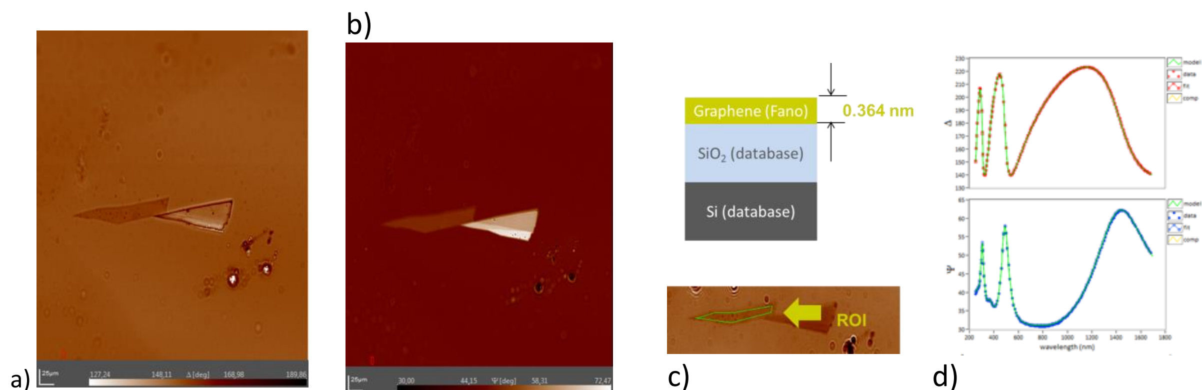

Fig. 1 Spectroscopic imaging ellipsometric measurement of a Graphene flake: Delta (a) and Psi (b) map – examples of a graphene flake, selected Region of Interest and Optical model (c) and wavelength spectra of Delta and Psi, (d) extracted for the ROI from Delta and Psi maps recorded for wavelengths in between 250 and 1700 nm (measured **data displayed as** points and model, line).

Conventional ellipsometry is well established in the field of thin film metrology due to the exceptionally high resolution in the z-axis, enabling very accurate thickness measurements for nano- and microfilms. However, conventional ellipsometry does not have a sufficient lateral resolution for a number of the described developments nor a direct microscopic visualization with highest contrast. The approach of spectroscopic imaging ellipsometry (SIE) differs from conventional ellipsometry in that the measurements are based on a series of micrographs taken at dedicated orientations of the optical components. The primary measurements are microscopic maps of the ellipsometric angles Delta and Psi (Fig. 1 a, b) or micro maps of dedicated elements of the Müller Matrix. Areas can be condensed by binning, averaging of selected pixels data (Region of interest, ROI, Fig. 1c) of equivalent areas and by using histogram data of inhomogeneous regions.

Keywords: Imaging Ellipsometry, Graphene, 2D Materials,

References

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