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Quantitative analysis of pyrolytic carbon films by polarized light microscopy

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Abstract

The optical properties of differently textured pyrolytic carbon films were quantitatively analyzed by polarized light microscopy. For the investigation of optically anisotropic and birefringent materials such as pyrolytic graphite by polarized light microscopy, the light intensity measured after the analyzer was calculated in dependence of the relevant experimental parameters. These include the orientation of the optical axis of the sample relative to the polarization of the incoming light, the optical properties of the sample such as the reflection coefficients for ordinary and extraordinary rays and their relative phase shift and the angle of the analyzer. From these calculations, the dependence of the extinction angle on the complex reflection coefficients of the sample material for ordinary and extraordinary rays and their relative phase shift was determined. The calculations are essential for a correct interpretation and a quantitative analysis of the results of polarized light microscopy on birefringent samples. For the case of polarized light microscopy on pyrolytic carbon films synthesized at different experimental conditions, we show a good agreement of the experimental data with the corresponding calculations. From the fit of the experimental data, reflection coefficients and their relative phase shift were determined for differently textured pyrolytic carbon films. Extinction angles as high as 21° were measured for flat high-textured films, demonstrating a high degree of orientation of the graphene layers.

Keywords: pyrolytic carbon, graphite, extinction angle, polarized light microscopy