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Refractive index of graphite and graphene at wavelengths spanning the carbon 1s edge

Due to the resonantly enhanced birefringence of graphite and graphene across the carbon 1s absorption edge, these materials may open up new avenues for optical devices such as x-ray half- or quarter-wave plates. Such applications, however, require the knowledge of the refractive index across the carbon 1s absorption edge which is near 285 eV. Data for graphite are uncertain and the respective data for graphene have not been determined. Furthermore, the electronic structure of graphene is known to depend on its substrate, which may also affect the refractive index.

Based on measurements at the Australian Synchrotron the optical constants defining the refractive index at energies spanning the carbon 1s edge of both, highly oriented pyrolitic graphite (HOPG) and graphene, have been determined. The graphene was CVD-deposited and supported by copper foil.

The refractive index was extracted from the data via the piecewise Kramers-Kronig transformation of NEXAFS spectra. It has been found that with the associated optical constants successful simulations of reflection spectra for both materials are possible. The simulated spectra have been compared with results from recent experiments at the BESSY synchrotron in Berlin.

Primary author(s) : Mr WAHAB, Hud (UNSW Canberra)

Co-author(s) : Ms JANSING, Christine (Münster University of Applied Sciences, Münster, Germany); Prof. MERTINS, Hans-Christoph (Münster University of Applied Sciences, Münster, Germany); Prof. TIMMERS, Heiko (UNSW Canberra)

Presenter(s) : Mr WAHAB, Hud (UNSW Canberra)