PHONON-LIKE LIGHT SCATTERING IN POLYCRYSTALLINE CARBON STRUCTURES

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Summary

A new type of inelastic light scattering in a disordered condensed matter is considered, in which, contrary to the conventional Raman scattering with fixed frequencies of vibrations, a shift of vibrational band positions is observed under variation of the excitation radiation frequency. This phonon-like scattering is inherent to intermediate states of the matter characterized by a "smeared" zone structure at the transition from individual non-correlated molecules of an amorphous material to a highly correlated structural state in single crystals. In particular, for different carbon structures, the intermediate structural states between graphite and diamond include some shares of sp^2 and sp^3 hybridizations. A defect band and additional ones (D and Ad bands, respectively) have been clearly detected in the Raman spectra of such carbon forms. The bands have a doublet frame with the "redistribution" of intensities between components of the doublet (at 1350 and 1375 cm^{-1}) in different structural modifications of graphite sensitive to the local environment of the corresponding chemical groups and to physical factors like pressure, temperature, and ionic implantation. The deconvolution of the composite bands into individual components has been performed through the subtraction spectra calculation. The origin of doublets and limitations of the applicability of a coupled double resonance concept are discussed. To determine the nature of the considered Raman bands, their fine structure and asymmetry are analyzed and compared with the behavior of similar bands in diamond-like hydrocarbon films and carbon metastable phases under high pressure.