

Structure of nitrogenated amorphous carbon films from NEXAFS

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Abstract

The change in the structure of tetrahedral amorphous carbon (ta-C) films by nitrogen incorporation is studied by near-edge X-ray absorption fine structure (NEXAFS) spectroscopy and electron energy-loss spectroscopy (EELS). NEXAFS spectroscopy can be used to determine the molecular structure of amorphous nitrogenated carbon (a-CN_x) films due to its superior energy resolution as compared to EELS. This shows the structure of the films to be close to pyridine. The N K-edge spectra obtained from these spectroscopic techniques are decomposed into several peaks in order to compare the film structure after nitrogen incorporation. A comparative and combined study of NEXAFS spectroscopy and EELS reveals that as the nitrogen concentration in the films increases, the peaks π^* and σ^* at the C K-edge move towards higher energy and the π^*/σ^* intensity ratio at both edges decreases. These results indicate that there is an increase in the concentration of C=C and C=N relative to C---C and C---N bonds with nitrogen concentration, respectively. The difficulty of nitrogen doping of ta-C is also interpreted from the ratio of π^* and σ^* at C and N K-edges.

Author Keywords: Tetrahedral amorphous carbon; Carbon nitride; Near-edge X-ray absorption fine structure (NEXAFS); Density of states

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