

Stoichiometric carbon nitride synthesized by ion beam sputtering and post nitrogen ion implantation.

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Carbon nitride films have been deposited on Si (100) by ion beam sputtering a vitreous graphite target with nitrogen and argon ions with and without concurrent N₂ ion bombardment at room temperature. The sputtering beam energy was 1000 eV and the assisted beam energy was 300 eV with ion / atom arrival ratio ranging from 0.5 to 5. The carbon nitride films were deposited both as single layer directly on silicon substrate and as multilayer between two layers of stoichiometric amorphous silicon nitride and polycrystalline titanium nitride. The deposited films were implanted ex-situ with 30 keV nitrogen ions with various doses ranging from 1E17 to 4E17 ions.cm⁻² and 2 GeV xenon ion with a dose of 1E12 ions.cm⁻². The nitrogen concentration of the films was measured with Rutherford Backscattering (RBS), Secondary Neutral Mass Spectrometry (SNMS) and Parallel Electron Energy Loss Spectroscopy (PEELS). The nitrogen concentration for as deposited sample was 34 at% and stoichiometric carbon nitride C₃N₄ was achieved by post nitrogen implantation of the multi-layered films. Post bombardment of single layer carbon nitride films lead to reduction in the total nitrogen concentration. Carbon K edge structure obtained from PEELS analysis suggested that the amorphous C₃N₄ matrix was predominantly sp² bonded. This was confirmed by Fourier Transform Infra-Red Spectroscopy (FTIR) analysis of the single CN layer which showed the nitrogen was mostly bonded with carbon in nitrile (C≡N) and imine (C=N) groups. The microstructure of the film was determined by Transmission Electron Microscopy (TEM) which indicated that the films were amorphous.

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