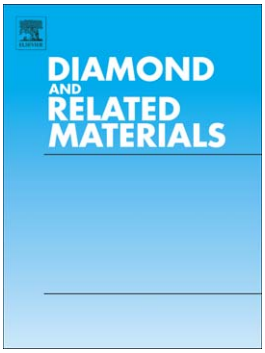

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Thermal release of hydrogen retained in multilayer graphene films prepared by mist-chemical vapor deposition

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Abstract

In this study, we investigated the absorption and thermal desorption processes of H and H_2O and the thickness of multilayer graphene films deposited on Cu foils using a mist-chemical vapor deposition method. Ion beam analysis techniques such as nuclear reaction analysis (NRA), elastic recoil detection (ERD), and Rutherford backscattering spectrometry (RBS) were employed. The RBS measurements revealed that the thickness of the multilayer graphene films was approximately 8±3 nm (24±9 layers). The depth distribution of H was analyzed using NRA and ERD. Based on these measurements, the residual H/C ratio for multilayer graphene was estimated to be approximately 0.03 in the bulk and 0.88 on the top-most surface. Additionally, the thermal desorption temperature for H from the multilayer graphene film was less than 373 K, which was much lower than that from isotropic graphite bulk (approximately 673 K). These results suggest that the thermal release of H did not occur because of desorption from sp^2- and sp^3-hybridized C atoms, such as intercalation and defect sites. Instead, it occurred owing to the desorption of H_2O adsorbed near the surface.