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Fabrication of carbon nanostructures by advanced plasma nano-processes

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Graphene-based nanocarbons include fullerene, carbon nanotube (CNT) and graphene sheet itself; nowadays they have a wide range of possible applications. Plasma enhanced-chemical vapor deposition (PECVD) can be easily applied to grow diamond, CNT and graphene films. In the case of PECVD, the main reaction mechanisms of deposition are determined by the species produced in the plasma. In the case of deposition of carbon-based materials, the balance between carbon precursors and etching radicals is important. Control of surface reaction is also important. Sometimes, pretreatment of substrate or selection of substrate is required for the nucleation. In short, for the synthesis and structure control of carbon nanostructures, we should consider the control of multiple radicals playing different roles such as carbon precursors and H atoms. In addition, control of surface reaction for the nucleation should be considered. For instance, ion flux onto substrate is unnecessary for plane graphene formation, but necessary for vertical grapheme nucleation on Si substrate. Moreover, pretreatment of substrate or selection of substrate would be crucial for synthesizing CNTs and graphene, catalyst nanoparticles for CNT growth and metal substrates (Ni and Cu) for plane graphene formation are these examples. We have investigated the synthesis of CNWs and planar few-layer graphene using PECVD with controlling the ion flux incident on the substrate and surface pretreatment with metal nanoparticles. For the growth of CNWs, ion bombardment on the substrate surface would play an important role in nucleation by creating active sites for neutral radical bonding, resulting in the formation of vertical graphene. On one hand, by reducing the ion flux incident on Ni or Cu substrate, planar graphene can be formed. We focus on the structure control of CNWs during the growth processes to be used as platform of the electrochemical and bio applications.

Biography

Mineo Hiramatsu is a Full Professor of Department of Electrical and Electronic Engineering and the Director of Nanocarbon Research Center, Meijo University, Japan. He also serves as the Director of Research Institute, Meijo University. He has served as the Director of The Japan Society of Applied Physics. His main fields of research are plasma diagnostics and plasma processing for the synthesis of thin films and nanostructured materials. He has authored more than 100 scientific papers and patents on plasma processes for materials science.

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