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Synthesis of Carbon Nanowalls and Challenge for New Functional Devices

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Carbon nanowalls (CNWs), two-dimensional carbon nanostructures consisting of plane graphene layers, have been synthesized on the substrates without catalyst. The large surface area and thin edges of CNWs may provide us with opportunities for the various applications. In particular, vertically standing CNWs with high surface-to-volume ratio serve as an ideal material for the catalyst support for fuel cells and gas storage. Recently it is reported that one graphene sheet potentially has the high electron mobility and huge sustainable current. Therefore, it is expected that CNWs can be applied for the various kinds of electric devices. Moreover, in the case of application to an efficient emitter for electron field emission, thin edges with moderate spacing and the good uniformity in the height distribution of CNWs are very promising. We have proposed the novel plasma enhanced chemical vapor deposition (PECVD), which is a radical-controlled plasma process using radical injection technique, and demonstrated the fabrication of vertically aligned CNWs using PECVD assisted by H radical injection. By using the radical injection PECVD, we were able to control the CF_3 and H radical density and hereby synthesize the CNWs with a variety of the morphologies and structures. The electric properties of CNWs for advanced nanometer-scaled device were investigated. It was found that the CNWs of n and p-type were successfully formed by radical controlling. In addition, the nano-structure of CNWs indicated the good performance of the electron field emission properties. The surface area with nano-scale high aspect ratio showed the good water repellency, while the surface exposed to O_2 plasma become hydrophilic. These excellent characteristics can be applied for the bio device. On the basis of these results, the potential of CNWs for new functional devices will be introduced.