

물을 첨가한 탄소나노튜브의 저온 저압 합성

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Water-Assisted Synthesis of Carbon Nanotubes at Low Temperature and Low Pressure

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Abstract : Water-assisted synthesis of carbon nanotubes (CNTs) has been intensively studied in recent years, reporting that water vapor enhances the activity and lifetime of metal catalyst for the CNT growth. While most of these studies has been focused on the supergrowth of CNTs at high temperature, rarely has the similar approach been made for the CNT synthesis at low temperature. Since the metal catalyst are much less active at lower temperature, we expect that the addition of water vapor may increase the activity of catalyst more largely at lower temperature. We synthesized multi-walled CNTs at temperature as low as 360°C by introducing water vapor during growth. The water addition caused CNTs to grow ~3 times faster. Moreover, the water-assisted growth prolonged the termination of CNT growth, implying the enhancement of catalyst lifetime. In general, a thinner catalyst layer is likely to produce smaller-diameter, longer CNTs. In a similar manner, the water vapor had a greater effect on the growth of CNTs for a smaller thickness of catalyst in this study. To figure out the role of process gases, CNTs were grown in the first stage and then exposed to each of process gases in the second stage. It was shown that water vapor and hydrogen did not etch CNTs while acetylene led to the additional growth of CNTs even faster in the second stage. As-grown CNTs were characterized by scanning electron microscopy (SEM), high-resolution transmission electron microscopy (HRTEM), atomic force microscopy (AFM), and Raman spectroscopy.

Key Words : Low temperature, Carbon nanotube, Water-assisted