Comparison of characteristics of carbon nanotubes grown by plasma enhanced chemical vapor deposition and thermal chemical vapor deposition

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Carbon nanotube (CNT) is considered one of the most attractive materials due to its potential applications and unique properties since it was discovered. Especially, CNTs are potential candidates for cold cathode field emitter because of high aspect ratio and small radii of curvature at their tips with high chemical stability, thermal conductivity, and high mechanical strength. For the application of CNTs to the electron emitter, requirements for the selective area growth, low temperature growth, vertical alignment and large area growth should be satisfied. Among various growth methods such as electric arc method, laser ablution deposition and CVD (Chemical Vapor Deposition) including thermal, and plasma CVD, CVD has been regarded as one of the most promising methods. But, a precise control of length, diameter, density and tip morphology of CNTs in growth using CVD is not clearly understood nor fully developed. In this work, the effects of plasma in growth of carbon nanotube were investigated. Carbon nanotubes were thermally and plasma – assisted thermally grown on glass substrate respectively. We compared the morphology, length, diameter and density of CNTs as the presence of plasma. It was also examined emission properties and crystallinity of CNTs to understand the role of plasma. Then we found that CNTs grown by plasma assisted method have longer length and smaller diameter than thermally only. Emission property and crystallinity are improved in plasma-assisted grown CNTs compared with thermally grown CNTs at same temperature. This may be attributed to the fact that plasma can enhance the decomposition of carbon source and radicals in plasma can improve the crystallinity of CNTs.