

Carbon Source and Byproduct Diffusion Limit in the CVD Growth of Aligned Carbon Nanotube Arrays

xiang rong, Masayuki Kadowaki, Jyun Ookawa, Shigeo Maruyama

Department of Mechanical Engineering, The University of Tokyo

Contact e-mail: xiangrong@photon.t.u-tokyo.ac.jp

In the root growth of vertically aligned carbon nanotube (CNT) arrays, where carbon source has to diffuse through the thick forest to contribute to the CNT formation, a new kind of diffusion limit arises and becomes a unique mechanism for the growth deceleration. In the present work, a simple approach was proposed to distinguish diffusion-controlled process from kinetic-controlled one. It was possible to evaluate the diffusion limit in different chemical vapor deposition (CVD) systems via the same non-dimensional factor. The results, which agreed well with experiments, suggested that mm scale SWNT arrays were usually suffering from strong feedstock diffusion limit while the growth of MWNT arrays were free of diffusion difficulties. For the 30 micron SWNT in alcohol CCVD, the result revealed that hundreds of ppm water was generated by the ethanol decomposition at the root of the array during the growth, which might be fatal for the catalyst lifetime.