Supported Ni catalysts of nominal submonolayers grew single-walled carbon nanotubes.

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Fe, Co, and Ni are known catalytically effective to grow single-walled carbon nanotubes (SWNTs). However, when supported on oxide substrates, Ni tends to yield only multi-walled carbon nanotubes. Enhanced surface diffusion at the elevated growth temperature may cause coarsening of Ni catalyst nanoparticles, and adjusting the nominal Ni thickness should be crucial to control the particle size.

Using our combinatorial method [1], we screened the nominal thickness of Ni for a rather wide range (0.05-3.5nm) on SiO_2 and found that Ni nanoparticles did catalyze the growth of SWNTs by alcohol catalytic chemical vapor deposition [2] only when its nominal thickness was as thin as subnanometers. The yield of SWNTs was much smaller for Ni than Co although the optimum metal thickness is somewhat larger for Ni (~ 0.2 nm) than Co (~ 0.1 nm). The origin of this poorer catalytic activity may arise from the existence of inactive Ni nanoparticles or the growth of thinner SWNTs than Ni nanoparticles.

References:

[1] S. Noda, Y. Tsuji, Y. Murakami, and S. Maruyama, Appl. Phys. Lett. 86, 173106 (2005).

[2] S. Maruyama, R. Kojima, Y. Miyauchi, S. Chiashi, and M. Kohno, Chem. Phys. Lett. 360, 229 (2002).