A simple combinatorial method to discover binary catalysts that grow vertically aligned single-walled carbon nanotubes.

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Enhanced surface diffusion at the growth temperature of single-walled carbon nanotubes (SWNT) can cause coarsening of metal catalysts. By balancing the nominal thickness and surface diffusion length of metals, metal nanoparticles of desirable size are expected to form spontaneously under the SWNTs growth conditions. In the previous work [1], we screened the nominal thickness of Co on a single SiO_2/Si wafer by the *"Combinatorial Masked Deposition, CMD"* method [2] and identified in a single experimental run that cobalt nanoparticles from submonolayers can catalyze the growth of high-quality SWNTs by alcohol catalytic chemical vapor deposition (ACCVD [3]).

Co-Mo catalysts have shown effective to grow vertically aligned SWNTs [4, 5]. In this work, our CMD method was extended to binary catalysts. By simply setting a mask with a slit above a substrate during sputter-deposition, the nominal thickness of Mo (0.2-4 nm) and Co (0.2-8 nm) was independently screened on a single SiO_2/Si wafer. The yield of SWNTs grown by ACCVD on this wafer largely depended on the catalyst composition/load, and vertically aligned SWNTs grew at regions with Co loads slightly larger than Mo loads. Our combinatorial method, which can yield an exhaustive catalyst library on a substrate, will accelerate the development of SWNTs growth processes.

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