Selective growth of carbon nanotubes using preformed cobalt nanoparticle catalysts

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Since their discovery in 1991, carbon nanotubes have been investigated in detail for their use for various applications including Field effect transistors, interconnects, sensors etc.[1.2] We at Samsung are interested in their ballistic transport properties that make them attractive candidates to replace electromigration prone copper interconnects.[3] Currently, multiwalled nanotubes are being investigated for this purpose firmly focusing on achieving lower resistance (including contact resistance), better process integration, etc. One of the important parameters to reduce the resistance is by providing multiple pathways for transport of electrons. This can be achieved by simultaneously decreasing the diameter of the nanotube and increasing their density. In general nanotube diameter sizes well with the diameter of the transistion metal catalyst used for their growth. While use of metals in the semiconductor fabrication lines is limited to few metals that catalyse growth of the nanotube, it is highly preferable if a would-be candidate catalyzes selective growth of CNT on metals. This selectivity would greatly assist in decreasing the complexity of the overall process. As reported recently, cobalt nanoparticles fit very well into this description.[4]

In this presentation we use preformed cobalt nanoparticles synthesized using wet-colloidal approach as catalysts for selective growth of carbon nanotubes on model metal in TiN. We observed that under CVD conditions, cobalt nanoparticles on TiN catalysed growth of nanotubes, while the same was not observed on silicon oxide (figure 1). CNT growth profiles on various patterned substrates including hole patterns will be reported. A plausible mechanism behind selectivity will be provided by characterizing the nanoparticles' composition on various substrates using x-ray photoelectron spectroscopy, TEM,etc.

References:

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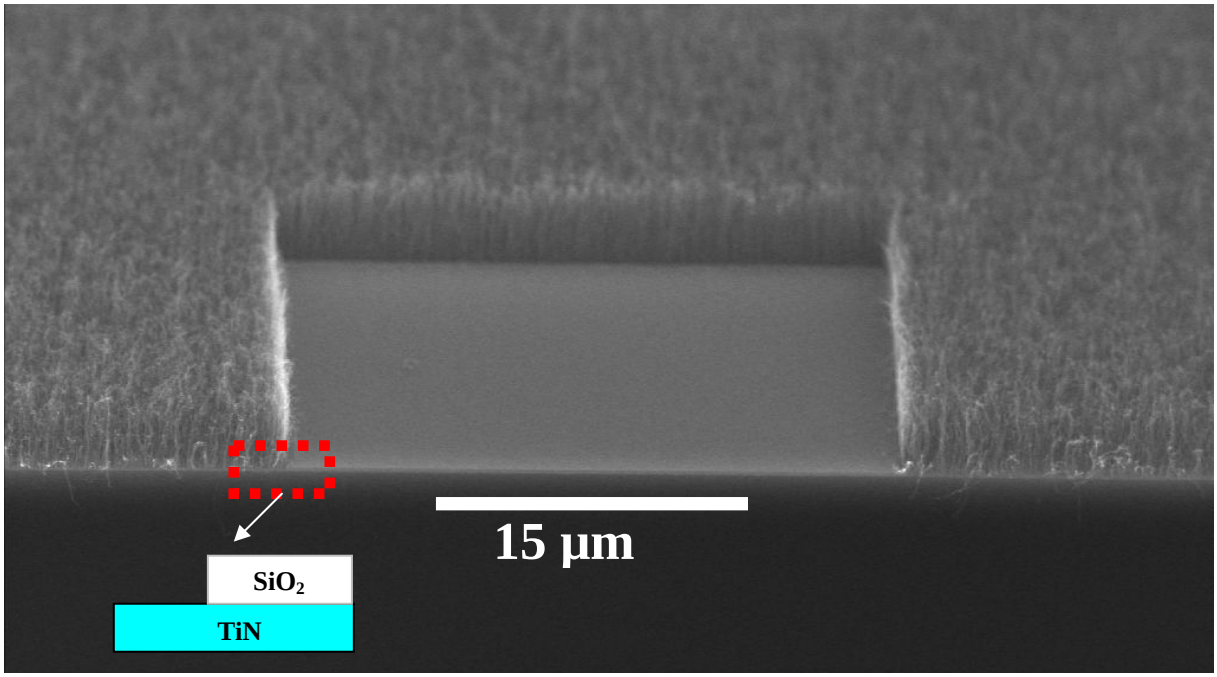

`Figure 1: SEM image of CNT grown using cobalt nanoparticles on patterned substrates.