Nanotube arrays synthesis for microwave applications

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Theoretical works have predicted that single-walled carbon nanotubes (SWNTs) have potential applications in high-frequency electronics. However, until now intensive study is obstructed by the very weak signals of SWNTs in the microwave regime. So fabrication of aligned arrays of SWNTs with very high density is the key to microwave applications of SWNTs. In our lab, we obtained very dense aligned arrays of SWNTs in a whole wafer scale by using quartz substrate and simple PDMS microcontact printing (μCP) technique.

Quartz substrate is the standard ST-cut wafer and it can guide the aligned growth of SWNTs (Kocabas, *et al*, Small, 1, 1110, 2005). The catalytic precursor is a mixture methanol solution of $FeCl_3$ and polyvinylpyrrolidone (PVP). By PDMS μCP, we can easily get patterns of catalysts on quartz wafers, and O_2 plasma was used to treat the wafer surface for getting rid of polymer. In a typical chemical vapor deposition (CVD) process, substrates were heated to 920˚C and reduced by H_2 (220 sccm) for 10 min. Subsequently, a flow of the CH_4/H_2 mixture gas (1100 sccm/220 sccm) was introduced for SWNTs growth. After 15 min., the furnace was cooled down to room temperature in Ar. SEM images show the density of aligned arrays is 1~4 SWNTs/μm and the arrays between the lines of catalysts are almost perfect without any random SWNTs in large areas.