Connected Silicon Nanowire Fabrication From CVD Of Silane

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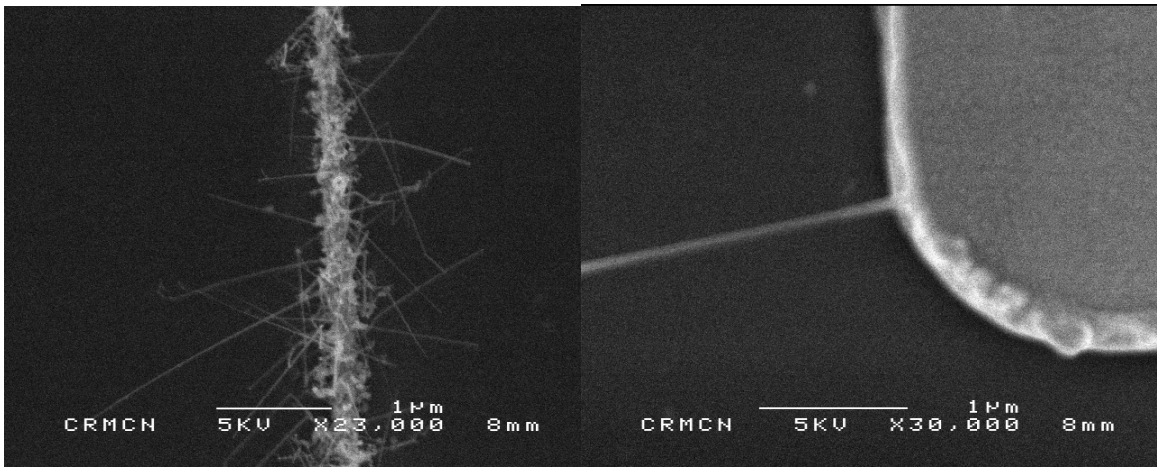
Semiconducting nanowires (NWs) present several interesting physical properties among which electrical properties are probably the most important from the point of view of applications (electronic devices, sensors…). The formation of silicon whiskers has already been studied from the dissociation of tetrachlorosilane ($SiCl_4$) molecules on silicon surface coated with gold clusters [1]. The growth of whiskers occurs via the so-called Vapor-Liquid-Solid (VLS) technique [2,3]. The mechanism involves a step of eutectic Au-Si alloy formation at sample temperature higher than 363°C, ie above the cracking temperature of $SiCl_4$ molecule (180°C). The permanent gaseous molecule decomposition induces the sur-saturation of the alloy and consequently the precipitation of silicon from the liquid alloy. Finally, one can observe on the sample silicon crystalline NWs, whose diameter is identical to the diameter of the gold clusters. The gold cluster 'catalysing' the gas decomposition remains always at the extremity of the NW during growth. The process feasibility has clearly been demonstrated and the actual challenge remains in the connection of a single Si NWs to integrate it in a device.

We have studied the growth of Si NWs from the decomposition of silane molecules (SiH_4) on gold nanoparticles [4]. To solve the problem of NWs connection, we have tried to initiate the growth reaction from a micronscale tungsten track, connected to gold pads, and preliminary coated with gold particles by sputtering. The tungsten track is then heated by Joule effect in the CVD reactor in an atmosphere of silane. The growth reaction starts above a threshold of electrical power injected in the wire and SiNWs grow at the centre of the tungsten wire, where the temperature is the highest. Ex-situ HRTEM analyses have shown that the SiNWs are coated with a 2 nm thick oxide sheath and the gold particle, whose diameter is identical to the diameter of silicon nanowire [5], remains at the NW extremity. Preliminary results on electrical measurements will be presented.



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