Surface Functionalization of 3C-SiC Nanowires

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One dimensional nanostrucures have potential applications in nanoscale electronic, optoelectronic or sensing devices. Core-shell nanowire (NW) structures of SiO_2/β-SiC and SiC-NWs are interesting for fundamental studies and technological applications: 3C-SiC is particularly appealing because of its good physical, chemical properties and biocompatibility, offering opportunities for nano-scale devices operating in biological environment. Moreover, functionalized 3C-SiC nanowires have the potential to act as highly sensitive detector elements in bio-chemical field.

Here, we report on the preliminary results of the functionalization of 3C-SiC nanowires with an optically active, thiophene-based, π-conjugated oligomer (PyT4). Oligothiophenes are semiconducting and fluorescent materials, widely used in organic electronics and biodiagnostic.

SiC/SiO_2 core/shell NWs grown by a Chemical Vapour Deposition (CVD) process on n-type Si (001) substrates, using carbon monoxide (CO) as the carbon source and nickel nitrate as the catalyst. The synthesis, performed at temperatures between 1050-1100°C.

3C-SiC NWs were grown in a home-made Vapor Phase Epitaxy (VPE) reactor using propane and silane as precursors (both diluted 3% in hydrogen) and a few nm of Ni as catalyst, deposited on Si(100) substrate using e-beam system. The nickel-deposited substrate is preheated at 1100°C for 5 minutes before introducing reagents for the grow time of 10 minutes.

SiC/SiO_2 core/shell NWs were then reacted with the triethoxysilane terminated with PyT4 to yield the hybrid NWs. The covalent grafting of the fluorophores was confirmed by fluorescence microscopy.

The nanowires were further characterised by X-ray diffraction, Scanning Electron Microscopy, Cathodoluminescence and Transmission Electron Microscopy.