Connectivity and contacts within nanoscale carbon networks

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Networks comprised of nanoscale carbon materials have attracted considerable attention in a wide range of application from flexible transparent conductors, to active layers in sensors to supercapacitors. These applications share a common need to understand the connectivity between the relevant nanoscale elements and how to optimise the contacts with external leads. Here in this talk we describe the use of conductance imaging atomic force microscopy (cAFM) to study junctions formed between carbon nanotubes in nanowire networks and graphene flakes in ultra thin graphene films. Charge transport in SWCNT networks is shown to be dominated by resistance at network junctions which scale with the size of the interconnecting bundles. The junction resistance can be controlled by acid treatment, and that the dominant effect of doping is a dramatic reduction of the barrier to transport between individual tubes and bundles. In the case of graphene films the interflake resistance scales with the flake thickness. Finally a novel approach to optimised nanotube-metal contacts has also been developed that makes use of the conductive probe to locally anneal the interface between the metal electrode and the nanotube by the controlled application of voltage pulses.