Novel functional inorganic nanotubes

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The authors` endeavours to synthesise, to analyse by state-of-the-art transmission electron microscopy (TEM) and to evaluate physical/chemical properties of novel inorganic nanotubes (NTs) will be presented [1-3]. Along with a general survey of diverse tubular nanostructures prepared and thoroughly studied, including various oxide (*e.g.* In_2O_3, MgO, SiO_2), sulphide (*e.g.* ZnS, GaS), phosphide (e.g. InP, Zn_3P_2), nitride (e.g. GaN, InN) and selenide (ZnSe) NTs and related structures, particular emphasis will be placed on the analysis of Boron Nitride NTs (BNNTs) – natural Carbon NT structural analogues. We will report on the significant breakthroughs in the multi-walled BNNT preparation at NIMS, Japan, through high-temperature induction heating and demonstrate a diverse range of BNNT mechanical, thermal, electrical and optical properties, and their unique potential for numerous interesting functional applications. These include nanocable insulation, field-effect-transistors, hydrogen accumulators etc. It appears that in many respects the BNNT promise exceeds that of standard C NTs. In particular, first transparent BNNT solutions were prepared and BNNT polymeric composite films were ultimately fabricated. They revealed dramatically enhanced mechanical and thermal properties. BNNT doping/functionalization towards smooth tuning of a band-gap, tube filling with metals, alloys, ceramics and inorganic compounds will also be highlighted. Finally, an electromechanical response of various individual NTs using a revolutionary technique that merges TEM and Scanning tunnelling microscopy (STM) set-ups will be displayed [4, 5]. The results will include but not limited to the striking effects of compressive or tensile deformation inside TEM on the electrical response of individual BNNTs and the first experimental signs of their unique piezoelectric behaviour.

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