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Inorganic nanotubes and fullerene-like nanoparticles at the crossroad between materials science and nanotechnology

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This presentation is aimed at underlying the principles, synthesis, characterization and applications of inorganic nanotubes (INT) and fullerne-like (IF) nanoparticles (NP) from 2-D layered compounds. While the high temperature synthesis and study of IF materials and INT from layered metal dichalcogenides, like WS_2 and MoS_2 remain a major challenge, progress with the synthesis of IF and INT structures from various other compounds has been realized, as well. Intercalation and doping of these nanostructures, which lends itself to interesting electronic properties, has been realized, too. Core-shell nanotubular structures, like PbI_2@WS_2 and SnS/SnS_2 and PbS/NbS_2 nanotubes from "misfit" compounds have been recently reported. Re doping of the IF and INT endow them with interesting electrical and other physio-chemical properties. Major progress has been achieved in elucidating the structure of INT and IF using advanced microscopy techniques, like aberration corrected TEM and electron tomography. Also recently, scaling up efforts in collaboration with "NanoMaterials" resulted in multikilogram production of (almost) pure multiwall WS_2 nanotubes phases. Extensive experimental and theoretical analysis of the mechanical properties of individual INT and more recently IF NP was performed casting light on their behavior in the macroscopic world. IF-MS_2 (M=W,Mo, etc) were shown to be superior solid lubricants in variety of forms, including an additive to various lubricating fluids/greases and for various self-lubricating coating. Full commercialization of products based on this technology is taking place now.