

**275a Inorganic Nanotubes and Inorganic Fullerene-like Materials from Layered Compounds: from Concept to Applications [Invited]**

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We have proposed in 1992 that nanoparticles of layered compounds will be unstable against folding and close into fullerene-like structures and nanotubes (IF). Initially this hypothesis was realized in WS<sub>2</sub>, MoS<sub>2</sub> and the respective diselenides. Subsequently, nanotubes and fullerene-like structures were prepared from numerous compounds with layered and recently also non-layered structure by various groups. Much progress has been achieved in the synthesis of inorganic nanotubes and fullerene-like nanoparticles of WS<sub>2</sub> and MoS<sub>2</sub> and many other metal dichalcogenides over the last few years. Synthetic methods for the production of multiwall WS<sub>2</sub> nanotubes by sulfidizing WO<sub>3</sub> nanoparticles have been described and further progress is underway. A fluidized-bed reactor for the synthesis of up to half a kg/day of fullerene-like WS<sub>2</sub> nanoparticles has been established in our lab, and the scaling-up of the synthesis to 100 kg/day is under way. The detailed mechanisms for the synthesis of fullerene-like WS<sub>2</sub> and MoS<sub>2</sub> nanoparticles and nanotubes of these compounds have been elucidated.

Substantial progress has been accomplished in the use of such nanoparticles for tribological applications and lately for nanocomposites, e.g. for impact resilient materials for self-protection. Few testing programs have been undertaken together with major industrial partners and have clearly indicated the usefulness of the fullerene-like WS<sub>2</sub> (MoS<sub>2</sub>) as solid lubricants in various products. These tests indicated that IF-MoS<sub>2</sub> and IF-WS<sub>2</sub> are heading for large scale applications in the automotive, machining, aerospace, electronics, medical and numerous other kinds of industries. This technology was licensed to “NanoMaterials”, which is currently involved in many collaborative development programs. Orders for about 1000 tons/year have been secured and further orders from major industrial partners are expected shortly. Novel applications of inorganic nanotubes in the fields of microelectronics; Li rechargeable batteries; medical and opto-electronic will be presented.