

SEMINAR

Monday 30/12/19, 12:00 pm

Building 211, seminar room

SPEAKER:

Prof. Reshef Tenne

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TOPIC:

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

Abstract:

After almost 100 years of research inorganic layered (2D) materials, like MoS_2 , are currently used as catalysts, lubricants, and perhaps most importantly in rechargeable Li-ion batteries. Much research is currently focused on monolayers (beyond graphene) of 2D materials and hybrids thereof in relation to their electronic and optoelectronics properties. After a short briefing on the history of 2D materials research,^{1,2} the concepts which led to the first synthesis of hollow-cage nanostructures, including nanotubes (INT) and fullerene-like (IF) nanoparticles from 2D compounds, will be presented. The progress with the high-temperature synthesis and characterization of new inorganic nanotubes (INT) and fullerene-like (IF) nanoparticles (NP) will be presented. In particular, the synthesis and structure of nanotubes from the ternary and more recently quaternary “misfit” layered compounds (MLC), like LnS-TaS_2 ($\text{Ln} = \text{La, Ce, Gd, etc}$), CaCoO-CoO_2 and numerous other MLC will be discussed.

Major progress has been achieved in elucidating the structure of INT and IF using advanced microscopy tools, like aberration corrected TEM and related techniques.

Mechanical, electrical and optical measurements of individual WS₂ nanotubes reveal their unique quasi-1D characteristics. This analyses demonstrate their unique behavior *vis a vis* the bulk phase, including quasi-1D superconductivity. Applications of the IF/INT as superior solid lubricants and reinforcing variety of polymers was demonstrated. Some of this research resulted in commercial products (a few spin-off companies), which are exploited world-wide with rapidly expanding marketshare. Few recent studies indicate that this brand of nanoparticles is less toxic than most nanoparticles and can be beneficial for several medical applications. With expanding product lines, manufacturing and sales, some of these nanomaterials are gradually becoming an industrial commodity.

1. L. Panchakarla, B. Visic and R. Tenne, "Perspective", *J. Am. Chem. Soc.* 2017, *139*, 12865-12878.
 2. M. Serra, R. Arenal and R. Tenne, *Nanoscale* **11**, 8073-8090 (2019).
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