

Vortragsankündigung

Mittwoch, 18. Dezember 2024, 11.15 Uhr im SR I

Dr. Vojtech KUNDRAT

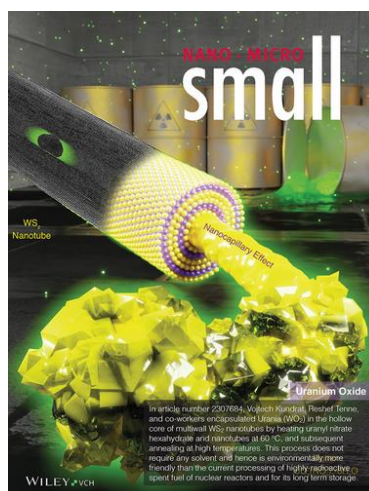
Weizmann Institute of Science, Rehovot, Israel / Thermo Fisher Scientific, Brno, CZ

“Synthesis and understanding of inorganic nanotubes through high-temperature synthesis and advanced electron microscopy techniques”

The topic of inorganic nanotube synthesis and some selected applications will be elucidated in the series of research projects. The main emphasis will be on understanding the procedures connected to the high-temperature conversion of tungsten suboxide nanowhiskers to the WS₂ multiwall nanotubes. The process was followed via *in-situ* and *ex-situ* scanning and transmission electron microscopies, respectively.¹ The exact reaction mechanism was then revealed on the atomic and layer-by-layer scale. In a follow-up study, the synthetic nuances were exploited to reach the ultralong WS₂ nanotubes with lengths reaching over half millimeters and on. Such unique materials promise opening new application playgrounds as demonstrated by assembling “WS₂ inorganic bucky paper” – felt-like materials capable of ultrafiltration of gold nanoparticles.²

Another new application of WS₂ nanotubes is the entrapment and encapsulation of uranium oxide within a nanotube lumen. The procedure is based on the facile melting of uranyl nitrate hydrate in the presence of WS₂ nanotube powder. Chemical changes during the encapsulation were closely followed by XPS and XRD analyses. The procedure could be eventually exploited as a storage protocol for highly active and hazardous nuclear materials, including other isotopes capable of forming low melting salts.³

The final part of the talk will be focused on the description of synthesis advanced inorganic nanotubes, WTe₂, MoTe₂, ReSe₂ and ReS₂ utilizing Van der Waals epitaxy. The developed synthetic protocol exploits WS₂ nanotubes as useful substrate for deposition additional layers. New compounds deposited on the top of the nanotube copy the curvature of WS₂ nanotubes, ultimately forming core-shell WS₂ – MX₂ nanotubular structures. This methodology allows formation of unprecedented nanotubular structures, challenging for synthesis in the classical manner.^{4,5}



- (1) Kunderát, V.; Novák, L.; Bukvišová, K.; Zálešák, J.; Kolíbalová, E.; Rosentsveig, R.; Sreedhara, M. B.; Shalom, H.; Yadgarov, L.; Zak, A.; Kolíbal, M.; Tenne, R. Mechanism of WS₂ Nanotube Formation Revealed by *in Situ* / *Ex Situ* Imaging. *ACS Nano* **2024**, *18* (19), 12284–12294. <https://doi.org/10.1021/acsnano.4c01150>.
- (2) Kunderát, V.; Rosentsveig, R.; Bukvišová, K.; Citterberg, D.; Kolíbal, M.; Keren, S.; Pinkas, I.; Yaffe, O.; Zak, A.; Tenne, R. Submillimeter-Long WS₂ Nanotubes: The Pathway to Inorganic Buckypaper. *Nano Lett.* **2023**, *23* (22), 10259–10266. <https://doi.org/10.1021/acs.nanolett.3c02783>.
- (3) Kunderat, V.; Cohen, H.; Kossoy, A.; Bonani, W.; Houben, L.; Zalesak, J.; Wu, B.; Sofer, Z.; Popa, K.; Tenne, R. Encapsulation of Uranium Oxide in Multiwall WS₂ Nanotubes. *Small* **2023**, 2307684. <https://doi.org/10.1002/sml.202307684>.
- (4) Kunderat, V.; Houben, L.; Zalesak, J.; Pinkas, I.; Rosentsveig, R.; Tenne, R. Core-Shell Nanotubes from Tungsten/Molybdenum Ditelluride-Tungsten Disulfide via Van Der Waals Epitaxy. American Chemical Society (ACS) September 9, 2024. <https://doi.org/10.26434/chemrxiv-2024-8zm9v>.
- (5) Koma, A. Van Der Waals Epitaxy—a New Epitaxial Growth Method for a Highly Lattice-Mismatched System. *Thin Solid Films* **1992**, *216* (1), 72–76. [https://doi.org/10.1016/0040-6090\(92\)90872-9](https://doi.org/10.1016/0040-6090(92)90872-9).