Czech Chemical Society Lecture

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University Campus Bohunice, Kamenice 5, Building B11 / room 132

Formation and understanding of inorganic nanotubes through high-temperature synthesis and advanced electron microscopy techniques

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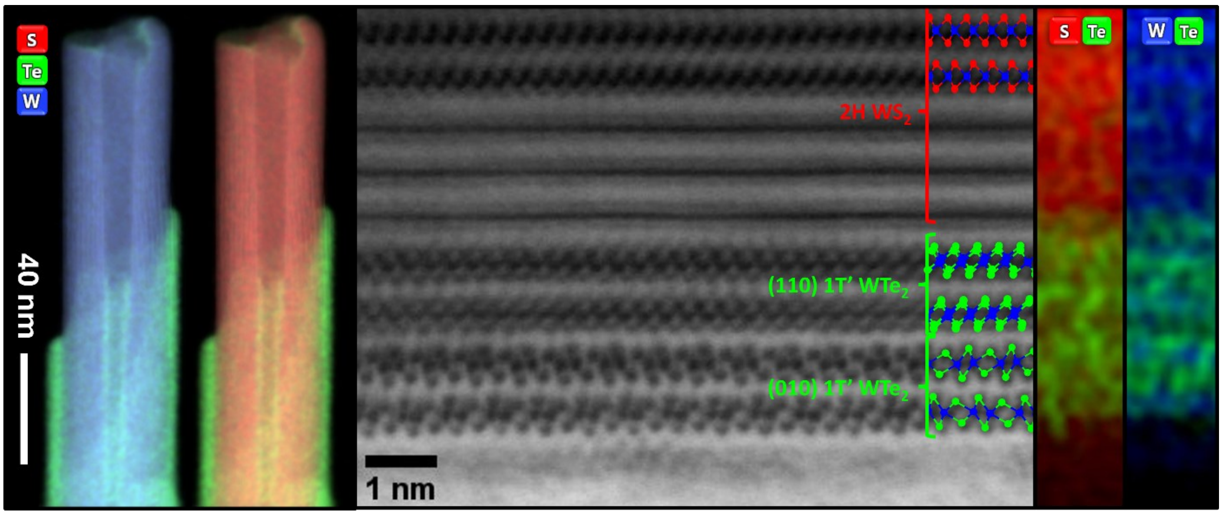
The topic of inorganic nanotube synthesis and some selected applications will be elucidated in the series of research projects. The main emphasis will be on understanding the procedures connected to the high-temperature conversion of tungsten suboxide nanowhiskers to the WS_2 multiwall nanotubes. The 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 WS_2 nanotubes with lengths reaching over half millimeters and on. Such unique materials promise opening new application playgrounds as demonstrated by assembling "WS_2 inorganic bucky paper" – felt-like materials capable of ultrafiltration of gold nanoparticles.[2]

Another new application of WS_2 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 WS_2 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 the synthesis of advanced inorganic nanotubes, WTe2, MoTe2, ReSe2, and ReS2, utilizing Van der Waals epitaxy. The developed synthetic protocol exploits WS_2 nanotubes as a useful substrate for the deposition of additional layers. New compounds deposited on the top of the nanotube copy the curvature of WS_2 nanotubes, ultimately forming core-shell WS_2 – MX_2 nanotubular structures. This methodology allows the formation of unprecedented nanotubular structures, challenging for synthesis in the classical manner.[4,5]



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(3) Kundrat, 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 WS_2 Nanotubes. *Small* **2023**, 2307684. https://doi.org/10.1002/smll.202307684.

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