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Edited by Līga Grīnberga, Anatolijs Šarakovskis Institute of Solid State Physics,University of Latvia 8 Ķengaraga Street, LV-1063, Riga, Latvia
E-mail: issp@cfi.lu.lv www.cfi.lu.lv

Edited by Gunta Kunakova
University of Latvia, Jelgavas str. 1, Riga
E-mail: lu@lu.lv www.lu.lv

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THE USE OF TUNGSTATE NANOPARTICLES IN HYBRID X-RAY DETECTORS

Inga Pudza, Kaspars Pudzs, Georgijs Bakradze, Janis Cipa, Andrejs Tokmakovs, Alexei Kuzmin

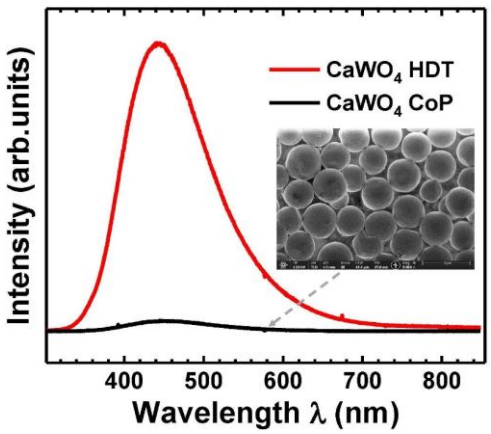
Institute of Solid State Physics, University of Latvia

Keywords
Tungstates, nanoparticles, XRD, SEM, X-ray absorption spectroscopy

Actuality and aim
Tungstates of divalent metals form a large class of materials with various applications including but not limited to scintillators, photocatalysis, supercapacitors and sensors. The high value of the atomic number of tungsten (Z=74) and the possibility to vary the atomic number of the second cation in a wide range (Z=12 for Mg, Z=56 for Ba) make tungstates attractive for the development of novel hybrid organic-inorganic X-ray detectors.

Methods
In this study, scheelite (A=Ca, Sr) and wolframite-type (A=Zn, Cd) tungstates with different crystallinity were prepared using co-precipitation (CoP) and hydrothermal (HDT) synthesis. Nano- and polycrystalline powders were characterized by XRD, scanning electron microscopy (SEM), X-ray absorption spectroscopy (XAS), Raman spectroscopy and X-ray excited optical luminescence (XEOL).

Results
Different synthesis parameters affect the size and morphology of nanoparticles (NPs). CoP at room temperature results in agglomerated NPs with an average size of 15-30 nm, but using citric acid as a capping agent the average size of NPs was smaller than 5 nm. However, XEOL is suppressed in NPs with low crystallinity because of high lattice defect concentration (see figure). In XAS spectra, size-induced local structure relaxations are observed which are more pronounced in NPs of wolframite-type. The HDT synthesis results in highly crystalline NPs with improved XEOL.



XEOL of two $CaWO_4$ samples.
A SEM micrograph of $CaWO_4$ microspheres is shown in the inset.

Conclusions
We show that the best sensitivity to X-rays is determined by a subtle interplay between particle size and their crystallinity.

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