FUNCTIONAL MATERIALS
& NANOTECHNOLOGIES

NIBS conference 2022
Nanotechnology | Innovation | Baltic Sea Region

Joint International Conference
Functional Materials and Nanotechnologies and
Nanotechnology and Innovation in the Baltic Sea Region

FM&NT – NIBS 2022

Riga, Latvia
July 3 – July 6, 2022

BOOK OF ABSTRACTS

INSTITUTE OF SOLID STATE PHYSICS
UNIVERSITY OF LATVIA

UNIVERSITY OF LATVIA
INSTITUTE OF
CHEMICAL PHYSICS

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

ISBN 978-9934-23-645-7 (for pdf files)
ISBN 978-9934-23-644-0 (for USB files)

DIRECT OBSERVATION OF CRYSTAL FIELD SPLITTING IN TUNGSTATES BY RESONANT X-RAY EMISSION SPECTROSCOPY

Alexei Kuzmin [1], Aleksandr Kalinko [2], Inga Pudza [3], Georgijs Bakradze [3], Maria A. Naumova [2]

[1.] Institute of Solid State Physics, University of Latvia, Kengaraga street 8, LV-1063 Riga, Latvia , [2.] Deutsches Elektronen-Synchrotron (DESY) – A Research Centre of the Helmholtz Association, Notkestrasse 85, D-22607 Hamburg, Germany, [3.] Institute of Solid State Physics, University of Latvia, Kengaraga street 8, LV-1063 Riga, Latvia

Keywords

Resonant X-ray emission spectroscopy, Crystal-field splitting

Actuality and aim

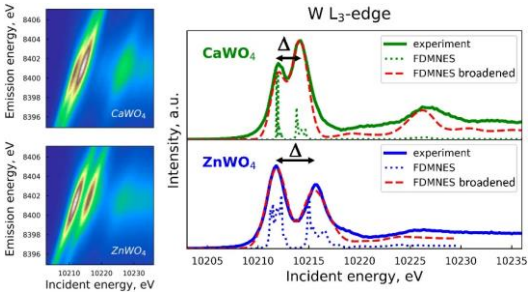
Resonant X-ray emission spectroscopy (RXES) is a photon-in photon-out X-ray technique providing information on the electronic states of metal with element selectivity and high energy resolution. It was successfully employed by us recently to study phase transitions in $CuMo_{1-x}W_xO_4$ solid solutions [1]. Here we demonstrate the sensitivity of the method to crystal field splitting in a series of AWO_4 (A=Mg, Ca, Zn, Cd, Sn, Pb) tungstates.

Methods

Polycrystalline tungstates were studied using the RXES technique by detecting W L_beta1 and L_alfa1 emission while scanning across the W L2,3-edges. The RXES map measurements were performed using von Hamos-type X-ray emission spectrometer at the HASYLAB DESY PETRA-III beamline P64 [2,3], and high-energy resolution fluorescence detected X-ray absorption near-edge structures (HERFD-XANES) were determined from the RXES maps. They were interpreted using the full-multiple-scattering XANES calculations using ab initio real-space FDMNES code [4].

Results

The RXES maps and corresponding HERFD-XANES spectra (see figure for Ca(Zn)WO4) reveal the structure of the unoccupied W 5d states and their splitting in the tetrahedral (1.3-2.0 eV) and octahedral (3.6-3.9 eV) crystal fields. The experimental results agree well with the calculations.



Experimental RXES maps and HERFD-XANES spectra for $CaWO_4$ and $ZnWO_4$ compared with the calculations.

Conclusions

Thus, RXES allows one to probe the splitting of the conduction band states in tungstates. The type of the splitting can be used as a fingerprint for different crystal lattices.

Acknowledgements

Financial support by the Latvian Council of Science project no. lzp-2019/1-0071 is acknowledged.

References

[1] I. Pudza et al., Acta Mater. 205 (2021) 116581.
[2] W.A. Caliebe et al., AIP Conf. Proc. 2054 (2019) 060031.
[3] A. Kalinko et al., J. Synchrotron Rad. 27 (2020) 31.
[4] Y. Joly, Phys. Rev. B 63 (2001) 125120.