PhD STUDIES COURSE UNIT DESCRIPTION

Name of subject	Field of science, code	Faculty / Center	Department
Thin film XRD	Chemistry N 003	FTMC	Characterization of Materials Structure
Student's workload	**Credits**	**Student's workload**	**Credits**
Lectures		Consultations	
Independent study	3	Seminars	

Course annotation

Methods of examination of thin layers based on X-ray diffraction are presented. The grazing (glancing) incidence method is used for X-ray diffraction measurements of thin layers (30 to 1500 nm) of polycrystalline materials. A parallel X-ray beam falling to the surface of a flat sample at a small angle (0,3 to 0,9º) slips over the surface of the sample over a large area, causing the x-rays diffraction in a much larger volume of material than Θ/Θ or Θ/2Θ methods and yields sufficiently intense X-ray diffraction peaks even in the case of thin layers. By changing the incidence angle of the X-rays, it is possible to get diffraction from different depths. Layers of only 1 to 10 nm thick can be analysed by the In-plane diffraction method, since special optics produce X-ray diffraction from the crystallographic planes of the layer perpendicular to the surface of the sample i.e. in contrast to the parallel planes in case of the Θ/Θ or Θ/2Θ methods. These methods of studying thin layers provide information on the phase composition of thin layers, the size of crystallites, the prevailing orientation of crystallites.
The X-ray reflectivity method examines the thickness, density and surface(s) roughness of thin layers (3-300 nm) or thin layer packets. This method may also cover non-crystal thin layers.

Reading list

1. Thin Film Analysis by X-Ray Scattering. Mario Birkholz. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2006.
2. Fundamentals of powder diffraction and structural characterization of materials. Vitalij K. Pecharsky, Peter Y. Zavalij. Springer Science+Business Media, Inc. 2003.

The names of consulting teachers	Science degree	Main scientific works published in a scientific field in last 5 year period
Remigijus Juškėnas	Doctor (habilitation procedure)	1. A. Drabavičius, A. Naujokaitis, G. Stalnionis, R. Giraitis, Z. Mockus, S. Kanapeckaitė, P. Kalinauskas, R. Nedzinskas, G. Niaura, R. Juškėnas. Photoelectrochemical, Raman spectroscopy, XRD and photoluminescence study of disorder in electrochemically deposited kesterite thin film. Journal of Alloys and Compounds 824 (2020) 153853. 2. P. Kalinauskas, E. Norkus, Z. Mockus, R. Giraitis, G. Stalnionis, V. Jasulaitienė, and R. Juškėnas. The influence of removal of secondary phases and dissolution by-product from the surface of Cu2ZnSnS4 film on the photoelectrochemical response of this film. Journal of The Electrochemical Society, 167 (2020) 026513 (6 pages). 3. M. Franckevičius, V. Pakštas, G. Grincienė, E. Kamarauskas, R. Giraitis, J Nekrasovas, A. Selskis, R. Juškėnas, G. Niaura. Efficiency improvement of superstrate CZTSSe solar cells processed by spray pyrolysis approach. Solar Energy 185 (2019) 283-289. 4. A.V. Stanchik, V.F. Gremenok, R. Juskenas, I.I. Tyukhov, M.S. Tivanov, Ch. Fettkenhauer, V.V. Shvartsman, R. Giraitis, U. Hagemann, D.C. Lupascu.

		Effects of selenization time and temperature on the growth of Cu2ZnSnSe4 thin films on a metal substrate for flexible solar cells. Solar Energy 178 (2019) 142–149. 5. R. Juškėnas, Z. Mockus, R. Giraitis, A. Selskis, G. Stalnionis, S. Kanapeckaitė, A. Drabavičius, P. Kalinauskas, G. Niaura. Structural and photoelectrochemical characterization of Cu_2SnSe_3 thin films fabricated by electrochemical co-deposition and selenization. Journal of Alloys and Compounds 767 (2018) 345-352.

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Committee Chairman prof. habil. dr. Aivaras Kareiva