

EXTATIC

Extreme-ultraviolet and X-ray Training in Advanced Technologies for Interdisciplinary Cooperation

EXTATIC Project Proposal 2016

Project Title	Soft X-ray absorption spectroscopy using a compact, plasma EUV/SXR source for material science applications
Home University	Military University of Technology, Warsaw, Poland
Home University Supervisor	dr hab. inż. Przemyslaw Wachulak
Host University	Czech Technical University in Prague, Prague, Czech Republic
Host University Supervisor	Prof. Jiri Limpouch, Dr. Alexandr Jancarek
Third University	
Third Supervisor	
Associated Partner(s)	Institute of Physics, Polish Academy of Science, Warsaw, Poland
Associated Partner Supervisor(s)	Prof. Krystyna Ławniczak - Jabłońska
Project Outline (max 250 words)	X-ray absorption spectroscopy techniques, including a near edge X-ray absorption fine structure spectroscopy NEXAFS, is used to study chemistry and structure of atomic bonds in materials exhibiting sharp absorption edges in the electromagnetic spectrum by probing the electronic transitions from the inner, core level to the unoccupied states. Usually, for this purpose synchrotron sources [1] and free electron lasers are used. However, recently compact sources for soft X-ray (SXR) spectroscopy measurements are being employed as well [2]. In this project we are exploring a possibility to develop a compact laser plasma extreme ultraviolet (EUV) and SXR source for NEXAFS measurements. The system will be based on the gas puff target source, which has been successfully used so far in a variety of experiments, including EUV [3] and SXR [4] microscopy, tomography [5], photoionization of gasses [6] and radiography [7]. In this project a SXR emission from Krypton gas will be used to illuminate a thin film objects to measure spectra near the absorption edges of elements. Initially carbon based elements, such as thin polymer films will be used, but the method is not limited to carbon. Other elements can be studied as well, including calcium, nitrogen, oxygen and manganese up to a few hundreds of eV photon energy. The spectral measurements in this compact system will be performed using transmission grating spectrometer with 5000 l/mm grating as well as with grazing incidence spectrometer for lower energy measurements. Such compact desk top X-ray absorption spectroscopy system might be an interesting alternative to synchrotron based counterparts.
Relevant Reference(s)	[1] Journal of Alloys and Compounds 362, 1-2, 189-197 (2004) [2] J. Phys. D: Appl. Phys. 41, 105202 (2008) [3] Optics Express 19, 10, 9541-9550 (2011) [4] Applied Physics B 118, 573-578 (2015) [5] Appl. Phys. B 117, 1, 253-263 (2014) [6] Physica Scripta T161, 014061 (2014) [7] Laser and Particle Beams 33, 2, 293-298 (2015)

Lead University Profile

The Military University of Technology (MUT) (www.wat.edu.pl) is the largest university of its kind in Poland and offers studies for all levels of university education: Bachelor, Master and Doctoral. There are about 10 000 students studying at MUT who are educated by highly qualified research and teaching staff, among which are over 180 professors and 450 doctors. The Institute of Optoelectronics (IOE) (www.ioe.wat.edu.pl) is an interdisciplinary academic research institute with a mission to support research and education in optoelectronics and lasers. The research staff of 140 including 80 scientists and 60 engineers and technicians pursues numerous research projects funded by the government or industry. The Institute of Optoelectronics is a leading research institution on laser development and application in Poland. The specific areas of research activities in the field include: laser optics and electronics, laser systems, laser-matter interactions, laser cleaning, laser nanotechnology, laser ranging and sensing. The Laser-Matter Interaction (LMI) research group (www.ztl.wat.edu.pl/zoplzm) participating in the EXTATIC program is specializing in development of laser-driven X-ray and EUV sources and their applications in technology and biomedicine. The LMI group was involved in several EU sponsored projects and took part in joint experiments on X-ray and EUV generation at MPQ-Garching, Ecole Polytechnique-Palaiseau, MBI-Berlin, PALS-Prague, FLASH-Hamburg. Staff members: Prof. Henryk Fiedorowicz, leader of the Laser-Matter Interaction (LMI) research group (laser plasma physics, laser-matter interactions, laser plasma X-ray and EUV sources and optics). Dr. Andrzej Bartnik, Chief of the Laser Technology Section at the Institute of Optoelectronics (laser plasma physics, laser plasma x-ray and EUV sources and optics, processing polymers with EUV), Dr. Mirosław Szczurek, Deputy Director of the Institute of Optoelectronics (solid state laser systems). Dr. hab. Przemysław Wachulak (nanoimaging using laser-driven X-ray and EUV sources).