

Topic of the Congress: 5. Scientific examination of heritage and analytical applications using different radiation.

On the Application of X-rays for Research and Characterization of Cultural Heritage Objects / Materials

Carlos Sá¹

¹ CEMUP, Centro de Materiais da Universidade do Porto

Abstract: The discover of the X-ray radiation by Wilhelm Röntgen in 1895, has enabled new view sights on the material objects - natural and manmade - that surround us, giving a new perception of their macro and micro structure, and it was the source for a deeper knowledge of the intimate nature and structure of the matter.

First, with X-rays it became possible to get images - radiography - from inner (or hidden) parts of opaque and thick bodies, taking advantage of the large penetration depth, and from the exponential absorption law (with mass thickness) and from composition differential absorption. X-ray imaging made a long way to modern X-ray tomography and advanced X-ray microscopy, with a broad range of fields of application in science and technology. Second, the short wavelength and large quantum energy of X-rays, imply a complex interaction - absorption, scattering, diffraction, fluorescence - with matter (amorphous or crystalline), generating extended information about the elemental composition and order at the atomic and molecular level. In reason of these properties, X-rays are used in many essential technologies, and modern and advanced instruments, as primary and/or secondary radiation, for imaging, for elemental analysis and for structural characterization.

At CEMUP, X-rays find application in Scanning Electron Microscopy with X-ray Microanalysis (SEM/EDS) enabling local elemental composition analysis (X-ray emission at the micron size, nondestructive) of the exposed surfaces of objects in the course of microscopy examination, and in X-ray Photoelectron Spectroscopy, as primary radiation for detailed analysis (elemental composition and chemistry) of the top layer surface (thickness of less than 10 nm) of solid materials. These techniques find extended applications for the identification of composition, manufacture technology, the deterioration process and conservation of cultural heritage objects / materials, as it will be shown in the workshop.

Keywords: X-rays; XRD; XRF; SEM/EDX; XPS

BIO NOTE

Carlos Sá | cmsa@cemup.up.pt

Carlos Sá, is a senior researcher, Coordinator of the Unit for Image, Microstructure and Microanalysis - IMICROS and Director of Materials Centre of University of Porto – CEMUP.



Carlos Sá got his degree in Electrical Engineering in 1974 and his PhD, on the subject of Digital Image Processing and Analysis, at the University of Porto, in 1992. His academic activity involves research, research support and teaching in advanced training and specialization courses and seminars at CEMUP and in the frame of the curricular courses of the University of Porto, in the field of the high spatial resolution morphological and micro analytical characterization of materials surfaces, interfaces and microstructure - namely on Scanning Electron Microscopy and X-Ray Microanalysis (SEM/EDS), Electron Spectroscopy for Surface Analysis (XPS/AES), and Quantitative Metallographic and Image Analysis.

Carlos Sá is involved with CEMUP built up since 1981 until today, and he was in charge of setting up and organizing the operation of the laboratories, namely the coordination of equipment selection and installation, the technical personal training and the setup of management and of access and operation guidelines, for the laboratories of Scanning Electron Microscopy and X-Ray Microanalysis and Electron Backscattered Diffraction (SEM/EDS/EBSD), Electron Spectroscopy for Surface Analysis (XPS/AES), Scanning Probe Microscopy (SPM-AFM/MFM/STM) and Quantitative Metallographic and Image Analysis(LM/IA).

Carlos Sá is the Director of CEMUP since 2001, and is responsible for leading this infrastructure of University of Porto as a center of competence and shared advanced technological recourses in the fields of Advanced Materials Characterization, Structural Delineation and Micro and Nanofabrication for research support, advanced training and service to industry.

BRIEF AGENDA

	22.07.2015	Place
10:00 – 12:30	<ul style="list-style-type: none"> . Introduction. Review of fundamental properties of X-rays and X-rays matter interaction . X-ray methods and techniques for materials characterization, with a few examples 	CEMUP - Materials Centre of the University of Porto Rua do Campo Alegre, 823 4150 - 180 Porto http://www.cemup.up.pt

14:30 – 17:00	. Presentation of CEMUP experimental facilities for Scanning Electron Microscopy and X-ray Microanalysis (SEM/EDS) and for X-ray Photoelectron Spectroscopy (XPS) . Laboratory demonstration of SEM/EDS and of XPS	CEMUP - Materials Centre of the University of Porto Rua do Campo Alegre, 823 4150 - 180 Porto http://www.cemup.up.pt
---------------	---	--

NUMBER OF PARTICIPANTS

Minimum 8, maximum 15.

INDICATIONS TO PARTICIPANTS

Participants are invited to bring their own samples and materials for SEM/EDS.