

PORTABLE X-RAY SPECTROMETER FOR HIGH-RATE HIGH-RESOLUTION XRF ANALYSIS IN CULTURAL HERITAGE APPLICATIONS

A. Celani⁽¹⁾, R. Alberti⁽¹⁾, T. Frizzi⁽¹⁾, A. Longoni⁽²⁾, L. Miazzo⁽³⁾

⁽¹⁾XGLab SRL, via Moretto da Brescia 23, I-20133, Milano, Italy, ph. +390249660460, email info@xglab.it

⁽²⁾Politecnico di Milano, Dip. Elettronica e Informazione, Piazza L. da Vinci 32, I-20133, Milano, Italy

⁽³⁾Study and restoration of material constituting ancient furnishings, Via G. G. Mora 12, Milano, Italy

A novel compact, portable and reconfigurable X-ray fluorescence spectrometer designed for high rate and high resolution spectroscopy will be presented and its performance will be discussed.

The spectrometer is based on a 25mm² active area Silicon Drift Detector (SDD) characterized by an energy resolution of 125-130 eV on the Mn-K α line (5.895 keV) at 4 μ s shaping time at -50°C (Peltier cooled), peak-to-background ratio of the order of 10.000 and silicon thickness of 500 μ m. The excitation source is a low power 8W, 50kV, transmission X-Ray tube (Rh, Mo, W, Au or Ag anode) that can be equipped with several types of pin-hole collimators and filters to reach the best spatial resolution and excitation efficiency in different applications. The geometry of the source and detection system and the large solid angle of X-ray collection are optimized to obtain high counting-rate capability even if a low power X-ray tube is used.

In order to fully exploit the high rate performances of the detector, the spectrometer is equipped with a fast read-out electronics and a high throughput Multi-Channel-Analyzer that can transfer spectra to a PC by USB2 port or by wireless Bluetooth connection. The compact detection head (Fig. 1) is completed by many other sensors as a video-camera, a sonar and lasers for fine positioning and other anti-shock controls.

The main detection head can be installed into a shielded box and mounted on a five axis X-Y-Z- θ_1 - θ_2 remote controlled motorized stage (Fig. 2) that is responsible of sample scanning for automatic 2D elemental maps on 3D-surfaces. The spatial resolution is limited to 500 μ m by the X-ray spot diameter obtained with pin-hole collimators.

Finally the data are processed by a dedicated software that performs an automatic analysis of the spectrum allowing the identification of the elements that are present in the sample, the fitting of the spectra, and an iterative Fundamental Parameters (FP) analysis to provide the user with the quantitative elemental composition of the sample, as well as the on-line images of elemental mapping acquisitions.

The project is developed in the framework of the POR FESR Lombardia 2007-2013 “Valorizzazione del patrimonio culturale” ID-14481639 for cultural heritage conservation in Italy, and several examples of analysis of prestigious works of art will be presented and described. Other applications in the field of industrial technology and materials analysis will be shown as well.



Fig.1. The compact detection head with inside the complete X-Ray SDD detection unit, X-Ray Tube, service sensors. Overall dimension 250x167x110mm, weight <2kg. The unit can operate simply with power connection (12V DC) and a PC with USB2 or Bluetooth connection.

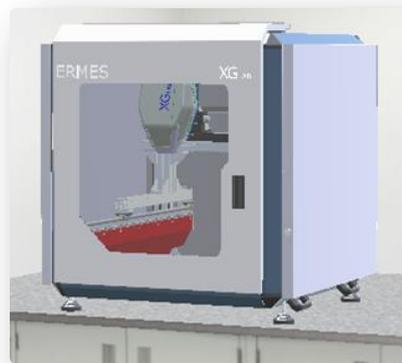


Fig.2. The detection head in a shielded box, mounted on a four axis remote controlled motorized stage