**X-ray fluorescence analysis: a technique unveiling the secrets of ancient and modern advanced materials and investigating traces of ancient alien life**

X-ray Fluorescence (XRF) spectrometry is an elemental analysis technique characterized by its exceptional versatility in probing almost any kind of sample (bulk, thin films, powders, particles, liquid, etc.), providing rapid qualitative and quantitative results [1, 2]. In XRF analysis, an exciting X-ray beam generates inner-shell (K-, L-, M-) ionization of sample atoms and subsequently the emission of elements, energy specific, X-rays (the so-called characteristic X-rays). The use of a variety of available modern X-ray sources and energy dispersive X-ray spectrometers enables the simultaneous identification and quantification of a given sample's constituent elements through almost the whole periodic table and within a broad dynamic range of concentrations, from ng/g (parts per billion) to wt.%.

The ultimate goal in applying XRF analysis is to determine the elemental composition of homogeneous, stratified or even 3D heterogeneous materials at different spatial scales, from micrometere sized samples to large (~m) objects, and to generate two or even three-dimensional element- specific concentration maps. These features and potentialities have met emerging interest in interdisciplinary applications, including material sciences, environmental monitoring, geology, cultural heritage and forensics, biology and medicine, paleontology, pharmacautical and cosmetics.

The seminar aims to provide a comprehensive introduction to the principles of XRF qualitative and quantitative analysis and explain the different standard and advanced modalities of the technique that allow its remarkable applicabillity, in small laboratories or synchrotrons, in the field or remotely. Selected XRF applications from different scientific fields will be presented with an emphasis on the characterization of modern [3, 5] and ancient materials [6, 7], whereas state- of- the- art developments and future perspectives of the technique will be addressed [8].


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