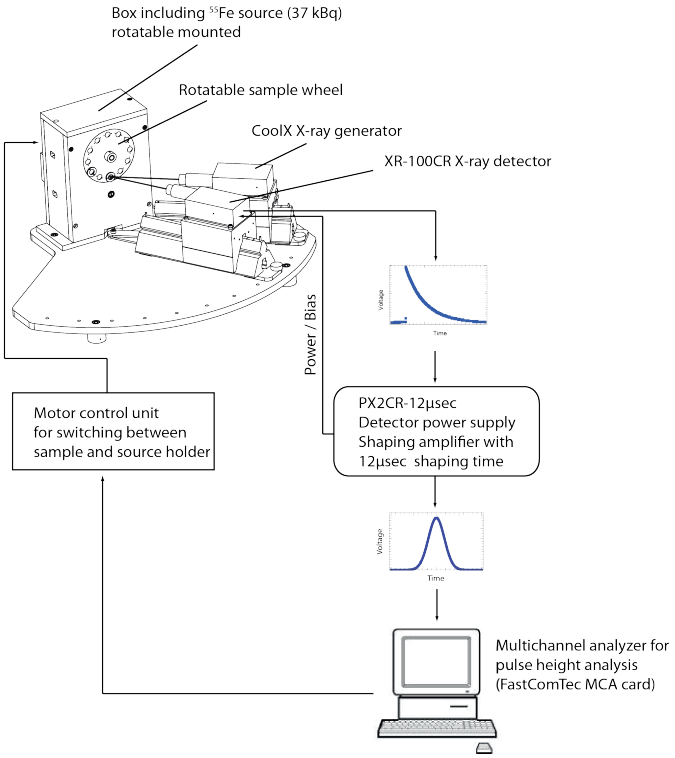
# X-Ray Fluorescence Experiment

## Abstract

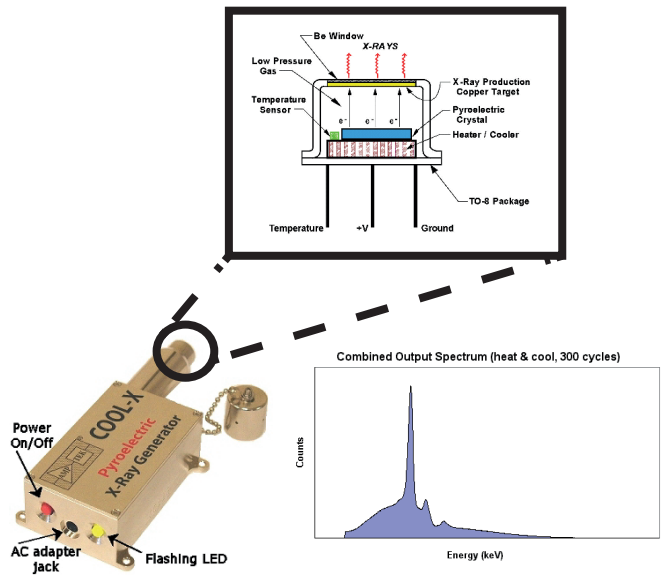
For a long time X-rays are applied for structural analysis in material, medical or biomedical science. Depending on the method, conclusions can be made on stoichiometric composition (PIXE, X-ray fluorescence, etc.) and constitution (X-ray crystallography, radiography) of sample material.
The basic idea of X-ray fluorescence is to bombard sample material with X-rays and to detect the characteristic secondary X-ray emitted from the investigated sample material. The goal of this Experiment is to investigate several samples by this method and to understand the basic physical concepts of X-rays.

## Experimental Setup



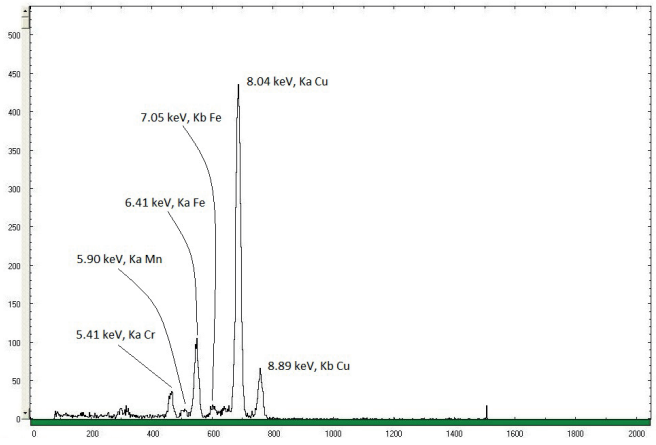

Several samples (Al, Cu, Pb, Brass and a gold plated coin) are mounted on a rotatable holder. An X-ray generator is irradiating the samples under investigation. The energy of the fluorescence radiation originating from the sample material is measured by a high resolving silicon detector.
Behind the sample wheel a $^{55}$Fe source ($E_{K(\alpha)}$: 5.9 keV, $E_{K(\beta)}$: 6.49 keV, $\tau_{1/2}$: 2.75 y) is mounted on a computer controllable holder for calibrating the detection system.
The data acquisition is performed by a PCI multichannel analyzer including a 8k ADC for pulse-height analysis.

## CoolX X-Ray Generator




When heated, a pyroelectric crystal exhibits spontaneous decrease of polarization. Hence, as the temperature increases, an electric field develops across the crystal. For a specific crystal orientation (-Z face pointing to the target), the top surface of the crystal gets positively charged and attracts electrons from the low pressure gas in the environment. As the electrons impinge on the surface of the crystal, they produce characteristic X-rays (Ta) as well as bremsstrahlung X-rays. When the cooling phase starts, the spontaneous polarization increases, and the electrons from the top surface of the crystal are accelerated towards the Cu target which is at ground potential. At this part of the cycle, Cu characteristic X-rays are produced as well as bremsstrahlung X-rays. When the crystal temperature reaches its low point, the heating phase starts again. The cycle time of the COOL-X can be varied from 2 to 5 minutes.

## Results




XRF can be used as a method to investigate sample composition. As an example the student should check a supposed gold coin for purity. The spectrum shows an intensive presence of Cu or Fe, which is an indication, that the coin is simply gold plated and not solid gold.

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