Proton Induced X-Ray Emission Applied to Thick Samples

Ahlberg, Mats; Akselsson, Roland; Johansson, Gerd; Johansson, Thomas B; Malmqvist, Klas

1975

"PROTON INDUCED X-RAY EMISSION APPLIED TO THICK SAMPLES"

M. Ahlberg, R. Akselsson, G. Johansson, T.B. Johansson and K. Malmqvist

Dep. of Nuclear Physics, Lund Institute of Technology.

Proton Induced X-ray Emission (PIXE) has been shown to be a sensitive method for the analysis of elements with atomic number $Z \geq 15$. Using protons in the MeV region and Si(Li)-detectors simultaneous determination of several elements down to 10^{-12}g in thin samples has been demonstrated (ref 1). However thin samples is often difficult or impossible to produce and severe contamination may occur why a possibility of analysing thick samples is desirable.

Due to the low range of MeV protons and the high absorption of X-rays around 10 keV in matter the volume analysed in thick samples is small. Hence the extreme sensitivity in absolute amounts results in comparatively moderate sensitivities when converted to concentrations. However as the proton beam is well focussed micro amounts of material can be analysed for trace elements with a sensitivity better than that of an electron microprobe.

In the analysis of steel surfaces it has been possible to obtain detection limits down to 10 ppm in a 10 minutes run for several elements even at the low energy side of the strong Fe K_α peak by use of a critical Cr-absorber (ref 2).

The determination of detection limits in human tooth enamel and dentine resulted in sensitivities down to 1 ppm in a 10 minutes analysis for most elements with characteristic X-ray energies greater than that of Ca K_β. However this was possible only when the high background radiation of bremsstrahlung from electrons accelerated on to the highly charged tooth was eliminated.

Ref 1: 'Multi-element trace analysis by proton induced X-ray emission", T.B. Johansson, thesis 1974.

Ref 2: "Proton induced X-ray analysis of steel surfaces for microprobe purposes",M Ahlberg, R Akselsson, D Brune and J Lorenzen, Nucl. Instr. Meth. 123, 385 (1975).