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A new target chamber for simultaneous Ion Beam Analysis at the University of Chile

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Abstract. A new experimental chamber has been installed at the 3.75 MeV Van de Graaff accelerator laboratory at the University of Chile. The aim of this facility is to perform simultaneous PIXE, PIGE, RBS and PESA analyses with a millimetre size beam. This chamber, manufactured by CINEL-Strumenti Scientifici, is designed for automatic analysis of a maximum of 30 targets affixed to a wheel driven remotely by a PC card interface and is currently equipped with a Si(Li) detector and two surface barrier detectors for RBS and PESA analysis. The spectrum is acquired with a CAMAC based data acquisition system with PelROOT interfacing software. The calibration of the PIXE set-up has been done with Micromatter thin film standards and other thick standards. The GUPIX software package recently installed in our laboratory has been used to process the PIXE spectra and the results were compared with certified values. For standarization the instrumental constant H (solid angle and correction factor) required by GUPIX is determined for a large set of elements. A similar procedure for RBS analysis has been done by means of the SIMNRA code. The chamber will be used in different studies like atmospheric aerosol samples, archaeometric materials, biological tissues and others.

Keywords: Target chamber, IBA analysis.

INTRODUCTION

In 1998 a KN3750 Van de Graff accelerator from HVE was installed at the Faculty of Sciencies of the University of Chile. Since then PIXE and RBS analysis, both recognized non-destructive and highly sensitive IBA methodologies, have been routinely performed to measure concentration of elements on different samples [1] using dedicated beam lines. However, and with the aim to obtain a more complete and simultaneous characterization of samples, a new multipurpose scattering chamber has been set into operation to perform standarized analysis with most of the nuclear analytical techniques (PIXE, PIGE, RBS, PESA) that can serve for continous research and applications. Also, this facility, manufactured by CINEL-Strumenti Scientifici (Vigonza –Italy) is designed for automatic analysis of a maximun of 30 samples affixed to a whell driven remotelly by an acquisition PC code. Recently, preliminary test measurements were carried out to identify the best conditions for these IBA analyses. Some applications on different types of samples are presented.

EXPERIMENTAL

The new beam line setup includes a NEC beam profile monitor Model FP3 and a set of collimators and steeres to control the beam along the line. The chamber has twelve lateral accessory ports at different angles and one port located under the chamber to connect a cryogenic detector. Up to now, one lateral port is used to connect two surface barrier detectors, a second to connect a Faraday Cup and a third is utilized as a beam viewer. A vacuum pressure of 10^{-6} Torr is achieved in the chamber using a turbolecular pump. A goniometer is used to position two EG&G surface barrier detectors for RBS (150^{o}) and PESA (30^{o}) analysis, respectively. Targets are affixed to a wheel driven remotely by a computer controlled module. Samples are irradiated with a 2.2 MeV proton beam of 2 2 mm^2 cross section. The beam, after passing

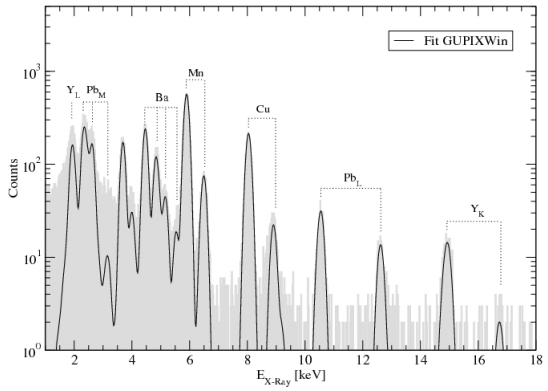

FIGURE 1. PIXE spectrum of multi-element sample.

through the target, is stopped at a Faraday Cup located at 0.5 m behing the sample position which along with an Elcor digital current integrator (Model A310B) are used to measure beam current (0.5 – 5 nA) and dose (1 uC). A CAMAC based data acquisition system allows spectra acquisition of detector signals. A detailed description of the whole laboratory is given in [1].

After passing through an exit window made of a 3.0 μm thick Mylar foil, X-Rays are detected by an ORTEC Si(Li) cryogenic detector Model SLP-06165 having 165 eV FWHM resolution at 5.9 keV. For the

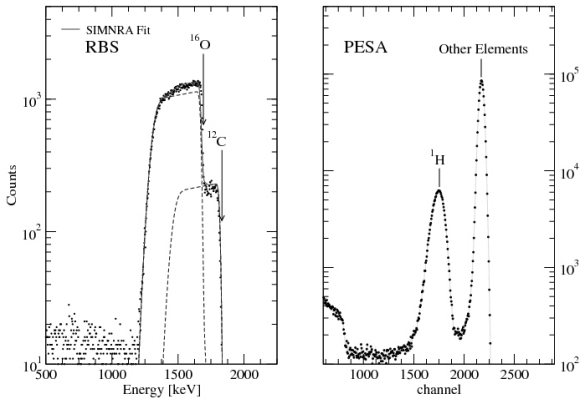

FIGURE 2. Proton scattering spectra on loaded aerosol filters, for PESA (θ= 30°) and RBS (θ = 150°), spectrum of multi-element sample.

ACKNOWLEDGMENTS

PESA and RBS measurements two fully depleted surface-barrier detectors (300 μm thickness, 50 mm^2 area, 20 keV FWHM) are used. Both detectors are placed 6 cm apart from the sample. The detector used to measure the H concentration is collimated to 1 mm^2, while the another detector, used to quantify C, N and O concentration is colimmated to 2 mm^2.

For the analysis of the PIXE spectra, the GUPIXWin Version 2.0[2] program is used. To calibrate our PIXE system, the H-Value method was used for which spectra from thin standards (Micromatter Inc.) were measured and compared to certified values given by the manufacturer (within 5%). After proper calibration, the H-values are store in the GUPIX library to process PIXE spectra. Fig. 1 shows the PIXE spectrum of a multi-element sample which is routinely used to calibrate the spectroscopy system.

On the other hand, spectra of samples of well-known concentrations (polipropilene, cellulose, Mylar, and Kapton, etc.) were collected to calibrate the RBS/PESA system. As a first application, RBS and PESA analyses have been performed on aerosol samples collected near the Lonquimay volcano (Chile). Fitted spectrum from RBS analysis (Fig.2a) by means of the SIMNRA software[3]. as well as PESA experimental spectrum (Fig. 2b) are shown, respectively.

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