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HEAVY ION PHYSICS

A Radiographic Technique With Heavy Ion Microbeams

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Abstract. In this work, we introduce a new technique to perform densitometric and multielemental analysis of samples at the same time using a simple detector with heavy ion micro-beams. It consists in the simultaneous analysis of X-rays induced in the sample and in a secondary target arranged behind the specimen. The X-rays originated in the secondary target are attenuated when crossing the specimen producing a radiographic image with a monochromatic source.

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1. Introduction

A heavy ion microprobe was recently installed at the Tandar Accelerator. Two techniques associated with this microprobe were implemented so far, namely: Micro-PIXE and STIM[1]. PIXE consists in the detection of X-rays induced in samples to perform trace element analysis. STIM consists in the measurement of the energy loss of the ion transmitted through the sample to determine the material density. Both have micrometric resolution. For quantitative characterization of trace elements it is necessary to use both techniques. This is cumbersome, because it requires for each sample two independent experiments. PIXE needs high currents (10^9 particles/sec) to enhance the production of X-rays induced but STIM requires low currents (200 particles/sec) to protect the detector. In this work we introduce a new technique to perform simultaneously densitometric and multielemental analysis of samples using only one detector.

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2. Technical Development

The new technique consists in the simultaneous analysis of the X-rays induced in the sample (multielemental analysis) and the radiographies produced by the attenuation of the X-rays induced in a secondary target behind the sample (densitometry)(Fig. 1), performing simultaneously trace element and densitometric measurements with a single Si(Li) detector. High ion currents are used to enhance the production of X-rays induced in both targets. The measured X-ray energy and their corresponding xy-beam position are stored for each event. Selecting conveniently the secondary target it is possible to identify the origin of the X-rays and discriminate the associated maps. X-rays from the secondary target are attenuated when traversing the sample, providing two-dimensional maps of the sample density. First experimental test results and numerical simulations are shown in Fig. 2. The production of X rays in targets was calculated considering its dependence with the beam energy, using experimental cross sections and the SRIM[2] code to calculate the beam energy as a function of depth.

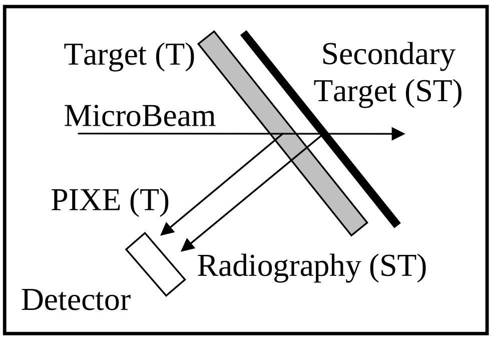

Fig. 1. The figure shows the experimental setup scheme used at the Tandar heavy ion microprobe. It was scanned a calibration grid of copper (T) with an iron secondary target (ST) behind the grid.

3. Conclusions

This promising technique is dependent on a suitable selection of the secondary target to be combined with the sample under study. At present, we are studying different combinations of samples-secondary targets to be used in experiments with biological and mineralogical samples.

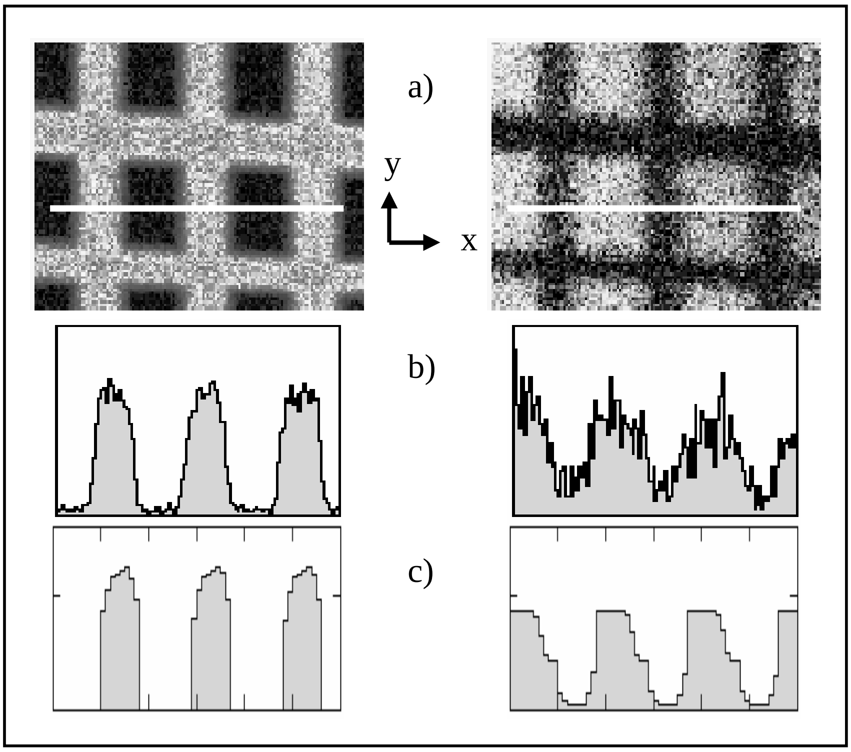

Fig. 2. Maps and intensities profiles of scan lines of Cu (left) and Fe (right) gates are showed. a) Maps obtained with the Tandar heavy ion microprobe. The white lines in the x direction indicate the regions of study. b) Experimental intensities profiles in the region of study. c) Simulated profiles in the same region.

Notes

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References

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