Use and Application of Ion Beam Analysis Methods

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An advantage of an ion beam over the electron beam in analysis of materials is its high penetration in the material (up to 100 μm) and low beam broadening. The measurements can be performed in the air with detection limits in the 10 ppm range. Typical depth of analyzed material is from few 100 nm up to 100 μm, depending on the geometry of the experimental setup, energy of the beam particles and density of a sample. Apart from analysis, modification of materials with an ion beam is also possible. Ion beam lithography is used to produce microstructures for specific applications in biology and medicine.

The IBA methods described are exercised at Microanalytical Center (MIC[1]) at Jožef Stefan Institute where the 2 MV tandem particle accelerator enables us to perform precise and accurate elemental analysis on various targets. The MIC accelerator was recently accepted in the SPIRIT consortium[2] of 11 leading ion beam facilities in EU, which provide transnational access to industry and R&D personnel in need of the ion beams for the modification and analysis of solid surfaces, interfaces, thin films and nanostructured systems.

In the past few years successful cooperation with leading research groups in the field of IBA was established and recently the interest from the high-tech industry was observed. Few examples of successful applications of IBA methods are presented further on:

- archaeology and art (glass[3], metals, ceramics, paint pigments),
- biological samples[4] (elemental distribution on micrometer scale, ion beam lithography),
- hydrogen/deuterium distribution in materials (fusion relevant materials[5], diamond-like coatings),
- aerosol samples measuring[6].

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[1] MIC: Microanalytical Center at Jožef Stefan Institute. http://www.rcp.ijs.si/mic, 2009.

[2] SPIRIT: support of public and industrial research using ion beam technology. http://www.spirit-ion.eu, 2009.

[3] Ž. Šmit, D. Jezeršek, T. Knific, J. Istenič, PIXE-PIGE analysis of Carolingian period glass from Slovenia, *Nuclear Instruments and Methods in Physics Research B,* 267 (1), pp. 121-124, 2009.

[4] K. Vogel-Mikuš, M. Regvar, J. Mesjasz-Przybyłowicz, W. J. Przybyłowicz, J. Simčič, P. Pelicon, M. Budnar, Spatial distribution of cadmium in leaves of metal hyperaccumulating Thlaspi praecox using micro-PIXE, *New Phytologist*, 179 (3), pp. 712-721, 2008.

[5] S. Markelj, P. Pelicon, J. Simčič, Z. Rupnik, I. Čadež, Studying permeation of hydrogen (H and D) through Palladium membrane dynamically with ERDA method, *Nuclear Instruments and Methods in Physics Research B* 261, pp. 498–503, 2007.

[6] M. Žitnik, M. Budnar, K. Ravnikar, M. Uršič, N. Grlj, M. Jakomin, Z. Rupnik, P. Pelicon, Estimation of possible airborne elemental inputs to the Slovenian marine environment, *Journal of Radioanalytical and Nuclear Chemistry*, Vol. 275 (1), 2008.