Non-destructive depth analysis of Sueki ceramics using confocal µXRF spectrometry combined with NAA data

Georg Gamauf[a], Lukas Perneczky[a], Anna Turyanskaya[a], Johannes H. Sterba[a], Christina Streli[a]*

*[a]Technische Universität Wien, Atominstitut, Stadionallee 2, 1020 Vienna, Austria *Corresponding author: jsterba@ati.ac.at*

Confocal Micro X-ray fluorescence spectrometry (confocal µXRF) is a non-destructive analysing technique allowing depth profiling of various samples.

Motivation

In-depth analysis could help us gain information about elemental composition of archaeological samples below the surface and therefore to get an insight into how those objects were created. We were interested in defining if there is a specific glazing covering the surface of the samples and if we could detect differences in elemental composition of surface layers compared to deeper layers of the samples.

Two pieces of ancient Sueki ceramics from Asia dated between 5th and 10th century were analysed by µXRF spectrometer (depth scans) and by neutron activation analysis [1]. An overview of one of the samples is presented in Fig. 1, where the measurement points are identified, too.

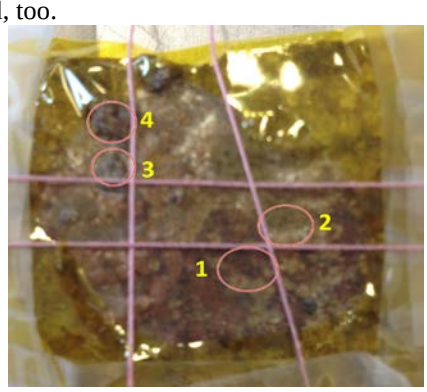

Figure 1: Sample prepared for measurements.

Setup

The ATI's µXRF spectrometer setup, which was designed in house, uses a low-power tube with Rh anode (20W) [2]. The measurements were performed under vacuum conditions, which allowed us measurements of low Z elements, e.g. magnesium. Minimization of absorption of low Z elements is also possible due to exploitation of 30 mm^2 LN2 cooled Si(Li) detector with an ultra-thin polymer window.

Depth-defined measurement is possible in confocal configuration by installing another x-ray polycapillary optics in front of the energy dispersive x-ray detector (see Fig.2). The overlap of the two foci creates a detection volume limiting the information depth. This volume can be moved inside the sample below the surface. The confocal volume of µXRF spectrometer was determined using a 10 µm Cu wire and for Cu-Kα (8 keV) it was 50x50x50 µm^3.

***Figure 2*:** Setup with mounted sample.

Results

Several points on each sample were measured, the results will be presented in form of graphs showing the differences between those areas of interest. The results of bulk NAA will be demonstrated for comparison.

[1] J.H. Sterba, H. Mommsen, G. Steinhauser, M. Bichler. The influence of different tempers on the composition of pottery. *J. Archaeol. Sci.* 2009, 36, 1582–1589.

[2] S. Smolek, B. Pemmer, M. Fölser, C. Streli, P. Wobrauschek. Confocal micro-X-ray fluorescence spectrometer for light element analysis. *Rev. Sci. Instrum.* 83 (2012) 083703.