TXRF CHARACTERIZATION OF INHOMOGENEOUS SOLIDS: INFLUENCE OF SURFACE MORPHOLOGY

Nikolai V. Alov [1], Kirill V. Oskolok [1], Axel Wittershagen [2] and Bernd O. Kolbesen [3]

[1] Department of Analytical Chemistry, M. V. Lomonosov Moscow State University, 119992 Moscow, Russia
[2] SEZ AG, 9500 Villach, Austria
[3] Department of Inorganic Chemistry / Analytical Chemistry, J. W. Goethe University of Frankfurt am Main, D-60439 Frankfurt am Main, Germany

Total reflection X-ray fluorescence spectroscopy (TXRF) as a hypersensitive method of solid surface elemental analysis is widely used for the analytical monitoring of semiconductor materials, in particular after their manufacturing and the direct treatment such as annealing, etching, cleaning, etc. [1].

The main purpose of analytical monitoring by TXRF is the correct determination of microimpurities in the surface layers of solids. The solution of this problem is simplified by practical absence of the matrix effects, but it is complicated by the ultra high sensitivity of the method to the "quality" of analyzed surfaces. In this case the surface "quality" can be described by three parameters: surface profile or morphology, degree of graininess of surface layers, surface and depth distribution of the elements determined. In other words, the surface "quality" is a degree of its inhomogeneity [2].

In this work we have estimated the influence of the surface morphology on the formation of the X-ray fluorescence line during TXRF measurements. The results of the theoretical description were tested by TXRF characterization of a number of model samples with all basic types of surface profiles (metal and alloy microphases on the plain surface of "light" low-density foreign material – glass-ceramic carbon). It was found that under the comparable quantities of metal contents, but substantially different types of surface morphology – uniform metal film vs. multiple individual three-dimensional crystallites – the relative intensity of the same X-ray fluorescence line of this metal can be changed by 100-1000 times (Fig.) [2]. The main reason of such a strong dependence is the change of conditions of the primary and fluorescence radiation scattering.

Thus we have shown that for the correct quantitative analysis of inhomogeneous solids it is very important to take into account the influence of surface morphology on the intensity of X-ray fluorescence line in TXRF spectra.

REFERENCES

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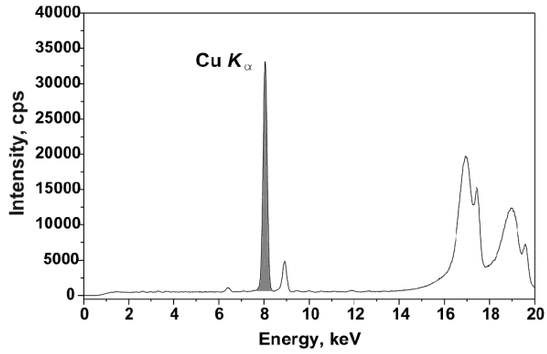
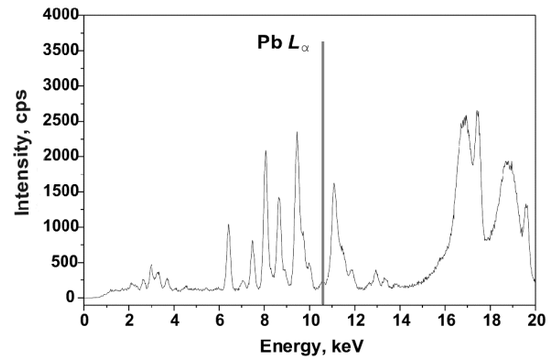
2. N.V. Alov, K.V. Oskolok, A. Wittershagen, M. Mertens, C. Rittmeyer, P. Rostam-Khani and B.O. Kolbesen, *Spectrochimica Acta Part B*, **56**, 2117 (2001).

Cu film



Pb 3-D islands



Pb 3-D islands + film of Cu-Pb solid solution

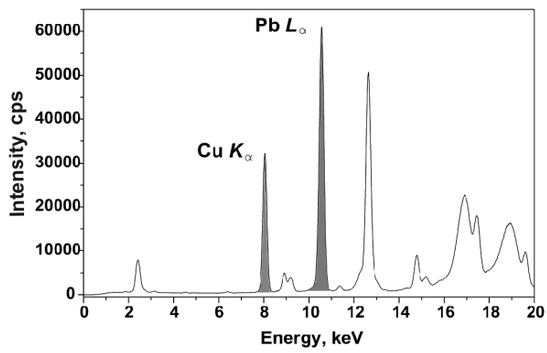


Fig. Experimental dependence of the intensity of X-ray fluorescence lines of copper and lead on the electrodeposit morphology during TXRF measurements of electrochemically modified surfaces of glass-ceramic carbon electrodes; total quantities of deposited metals are comparable.