

Chemical composition of molecular plated depositions of lanthanides and actinides investigated by Energy Dispersive X-ray Spectrometry (EDS)

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Scanning Electron Microscopy (SEM) is used to investigate the morphology of lanthanide and actinide depositions made by molecular plating, as shown in Figure 1 [1]. Here, uranium deposited on a titanium backing by molecular plating is displayed after drying.

In addition, Energy Dispersive X-Ray Spectrometry (EDS) gives information about the chemical composition of the deposited layer. The equipment used at the Institute of Geosciences at UMZ is the electron microscope DSM 962 by Zeiss®; the EDS-detector is an OXFORD –Instruments® Pentafet 6901. Investigations in SEM-BSE mode (Back Scattered Electrons) and the EDS microanalyses were performed at 20 kV.

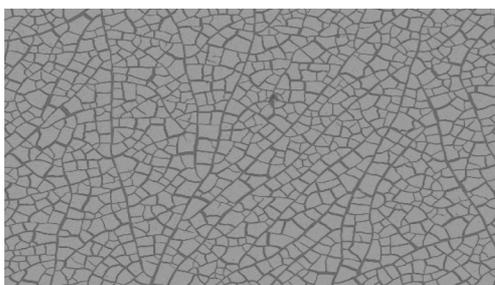


Figure 1: SEM-BSE micrograph of uranium on a titanium backing in a 200 x magnification.

Until now, it was still open, whether the lanthanide/actinide species is deposited in their nitrate form or as an oxide. A nitrate deposition seemed possible since the respective element is dissolved from its solid nitrate form prior to the molecular plating procedure.

As shown in the energy dispersive x-ray spectrum of the uranium layer on titanium backing in Figure 2, there might be a hint for a nitrogen transition (edge energy K-shell = 0.4016 keV [2]).

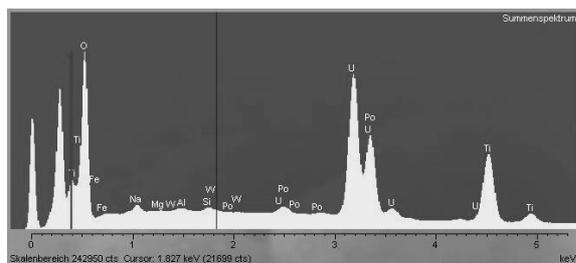


Figure 2: Energy dispersive x-ray spectrum of a uranium target on a titanium backing.

However, in the 400 – 500 eV range, there are also several LM-transition lines of titanium, which is predominantly present due to the backing material. Also, the edge energy of the oxygen K-shell is located nearby at 526 eV. All these lines may overlap a potential nitrogen line.

To exclude the influence of titanium, an uranium target on a tantalum backing (Ta LM transitions within 700 – 1000 eV) has been investigated as well. The parameters of the molecular plating procedure on the tantalum backing were the same as on the titanium backing. A close up of the region of interest is displayed in Figure 3. A conclusive nitrogen transition line is absent, although the oxygen line at 526 eV is still predominant. Therefore, we assume the lanthanide/actinide compound might be deposited in its oxide or hydroxide form rather than as nitrate.

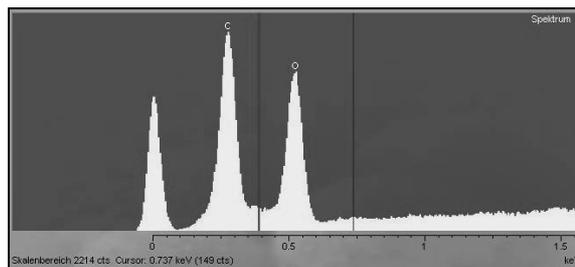


Figure 3: Close up of an energy dispersive x-ray spectrum of uranium on a tantalum backing

Ongoing investigations with alternative analytic methods such as XPS (X-ray Photoelectron Spectroscopy) will potentially verify this assumption.

References

- [1] D. Liebe et al., "The Application of Neutron Activation Analysis, Scanning Electron Microscope, and Radiographic Imaging for the Characterization of Electrochemically Deposited Layers of Lanthanide and Actinide Elements", Proceedings of the 23rd INTDS Conference, Tsukuba, Japan (15th-20th October 2006), submitted to Nucl. Instr. Meth.
- [2] R.D. Deslattes et al., X-ray Transition Energies (version 1.2).
Online: [http://physics.nist.gov/XrayTrans\[2007, Jan 12\]](http://physics.nist.gov/XrayTrans[2007, Jan 12].). National Institute of Standards and Technology, Gaithersburg, MD.