

Molecular plating of uranium on thin aluminum backings*

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Molecular plating is widely used for the deposition of lanthanide and actinide compounds on thin metallic backing foils [1]. At GSI and UMZ, this method has been previously applied on Ti or Be foils. Within the requirements of the TASCAP-Project (TransActinide Separator and Chemistry Apparatus) very thin foils of Al (2-10 μ m) as backing material have been proposed [2].

The general usability of very thin Al was investigated by a test series with Gd and U. For these tests, plating conditions were adopted unchanged from previous practices [3]. Although Al foils of less than 10 μ m in thickness are difficult to manage, they show no significant disadvantages compared to Ti or Be with molecular plating.

2-Propanol (isopropanol) as organic solvent has previously been used for the preparation of actinide targets on Ti and Be backings. But on Al, the stability of the U layer is not acceptable. The surface of most of the targets looked scaly or cracked associated with irreproducible plating yields. In order to solve these problems, an alternative solvent, 2-Methyl-1-Propanol (isobutanol) was tested. Table 1 compares the plating condition of the previously used isopropanol and the newly tested conditions applying isobutanol.

Table 1: Plating conditions for isopropanol and isobutanol (U on Al-Backing)

Solvent	Voltage [V]	Current [mA]	Plating time [h]	Thickn. [μ g/cm ²]
Iso-propanol	100-1200 stepwise	0.5 -3.0	1	390 [#]
Iso-butanol	150 V	0.01-0.5	4 - 5	650 ^{##}

The hygroscopic character of isopropanol might have been the reason for the poor surface quality since the plating solution as always been exposed to air for a couple of hours prior to the plating. The content of water may cause the relative high current and, thus, it possibly effects the formation of obstructing hydroxides at the surface of the backing foil. Isobutanol, which is also used by the target laboratory of the Lawrence Berkeley National Laboratory, LBNL, is less polar and therefore poorly water-soluble [4]. During numerous experiments, the plating conditions were adjusted to a lower voltage resulting in a longer plating time as shown in Table 1. With isobutanol, the coating looks more homogenous without visible cracks.

That has been approved with 25 μ m as well as 10 μ m Al backings. Fig 1 shows a light optical micrograph of an U-target, as usually prepared for the existing rotating actinide target wheel assembly at GSI.

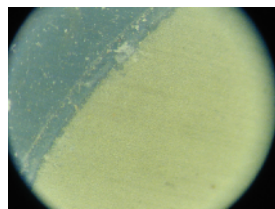


Fig 1: Uranium on Al Backing (25 μ m), plated from isobutanol within 3 h, Voltage 150 V

Furthermore, for U, a time dependence of the depositions yield has been determined. So far, a maximum yield at about 60 - 65 % is reached at a plating time of 5 h, as shown in Fig 2. In future investigations, the work will also focus on an increase of deposition yield to 75 % or more as achieved with isopropanol.

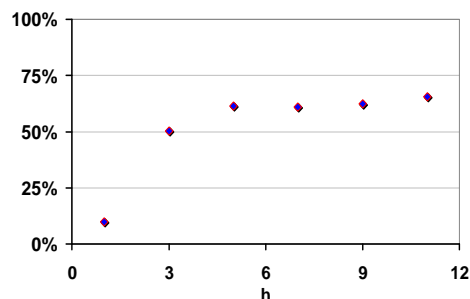


Fig 2: Time dependence of deposition yield at molecular plating of U on 25 μ m Al backing (from isobutanol with 150 V)

Next we plan to apply these conditions to other elements, especially various lanthanides. Also, the use of autoradiography [5] and REM/EDX will be further investigated to monitor target thickness, homogeneity and surface layer composition, respectively.

References

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corresponds to 74% at an intake of 500 μ g U/cm²

corresponds to 65% at an intake of 1000 μ g U/cm²