

Chemical Purification of Plutonium and Preparation of ^{242}Pu -Targets by Molecular Plating



- Dissolution of PuO_2
- Purification by Ion Exchange Chromatography
- Molecular Plating
- Preparation of ^{242}Pu -targets for CERN / n_TOF
- Summary

Thanks to



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Dissolution of PuO₂

About 220 mg of Pu oxide material,
enriched in ²⁴²Pu delivered from ORNL



Isotopic composition (wt % / assay date: February 28, 1980):

0.003 % ²³⁸Pu
0.005 % ²³⁹Pu
0.022 % ²⁴⁰Pu
0.009 % ²⁴¹Pu
99.959 % ²⁴²Pu
0.002 % ²⁴⁴Pu.

²⁴¹Am
432 a

²⁴¹Pu
14.3 a

⇒ Separation of ²⁴¹Am
by ion chromatography

Dissolution of PuO_2

**Pu oxide dissolved in a mixture of
15 mL 65 % HNO_3 and 5 mL 48 % HF at 80°C
⇒ Complete dissolution takes 3 days**



**Removal of fluoride-ions (that hinder deposition)
as $\text{BF}_3\uparrow$ ⇒ Add 4.4 M H_3BO_3 and heat to 80°C**



**Remove Pu as $\text{Pu}(\text{OH})_4\downarrow$ from boric acid solution
⇒ Add 25 % NH_3 -solution until pH 9 reached**



**Dissolve $\text{Pu}(\text{OH})_4$ in 8 M HCl
⇒ Complete Pu-recovery after second precipitation**

Separation of ^{241}Am

1)



Add 65 % HNO_3
to Pu solution

Separation of Am with
anion-exchanger
DOWEX AG1X8

Pu/Am
8 M HCl

2)

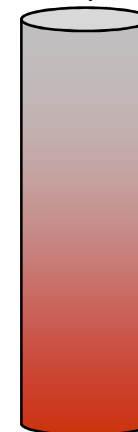


Am

0.5 M HCl

DOWEX
AG1X8
column

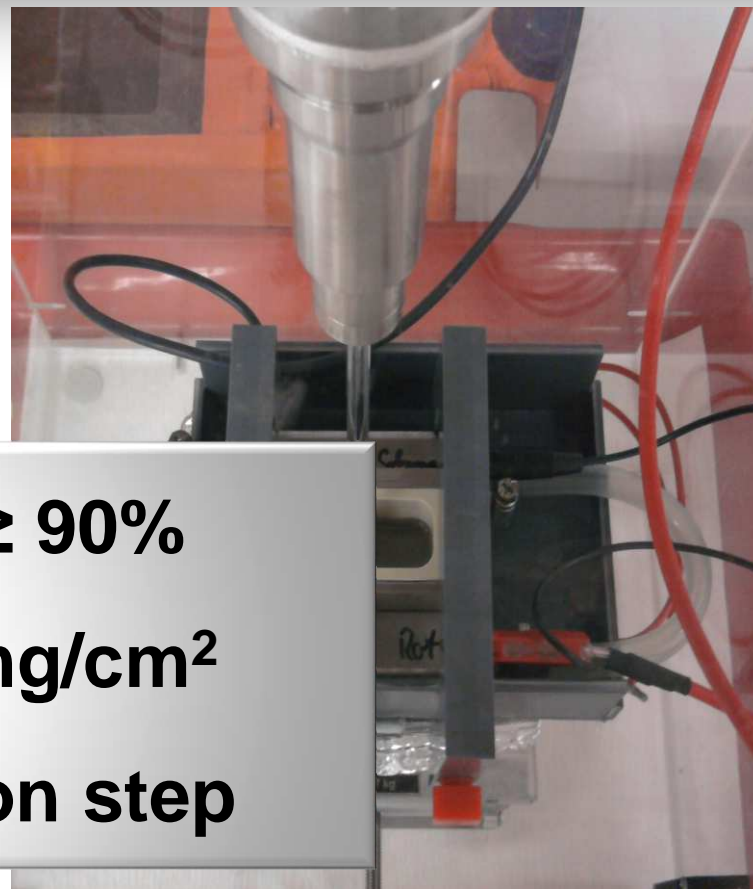
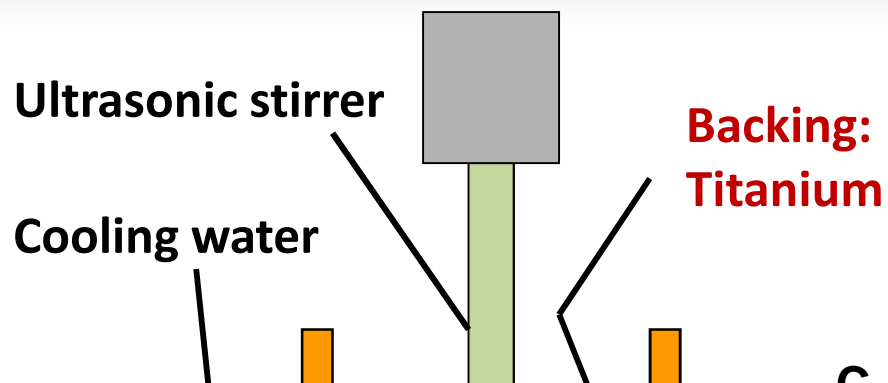
3)



Pu

Pu is eluted with 0.5 M HCl
 \Rightarrow **Pu-recovery $\geq 85\%$**

Actinide deposition by Molecular Plating



Deposition yield: $\geq 90\%$
Target thickness: mg/cm^2
in a single deposition step

Pd-foil

PEEK-cell

Actinide compound,
dissolved in
isobutanol

Voltage: 100 V - 1500 V

Deposition time:
2-6 hours

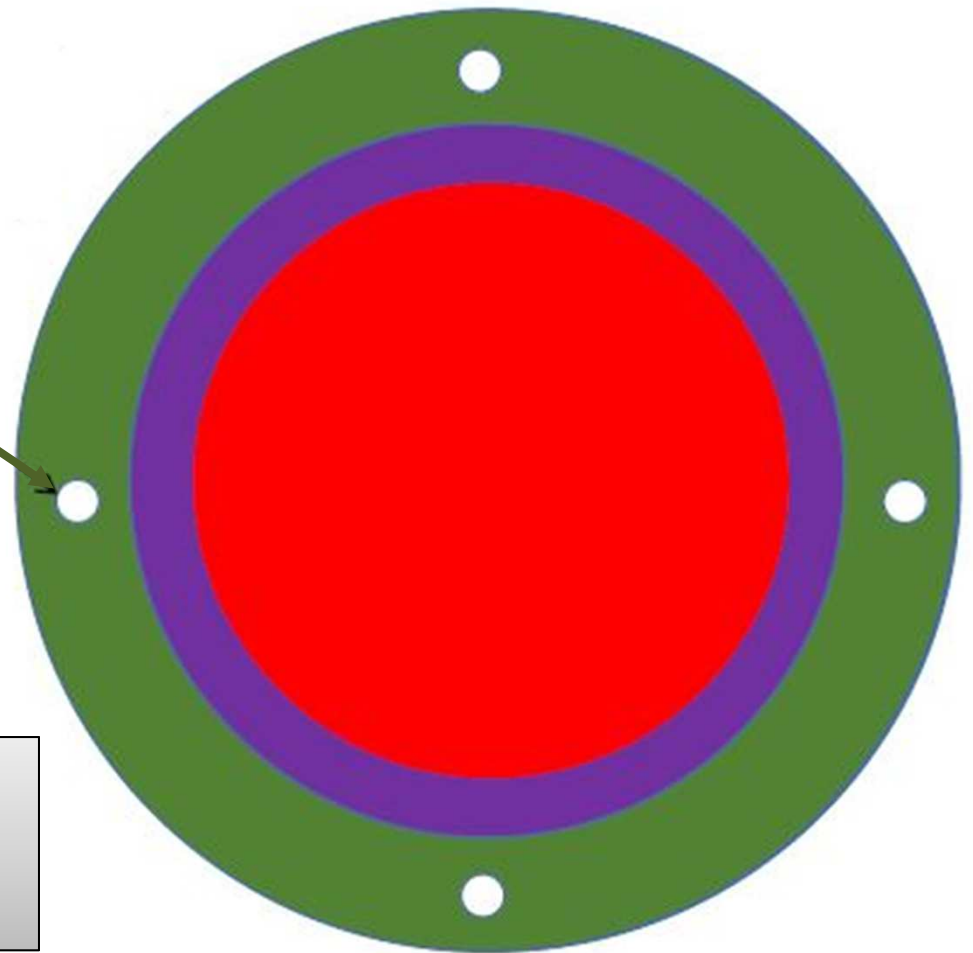




Pu-deposit ($\varnothing = 45$ mm)

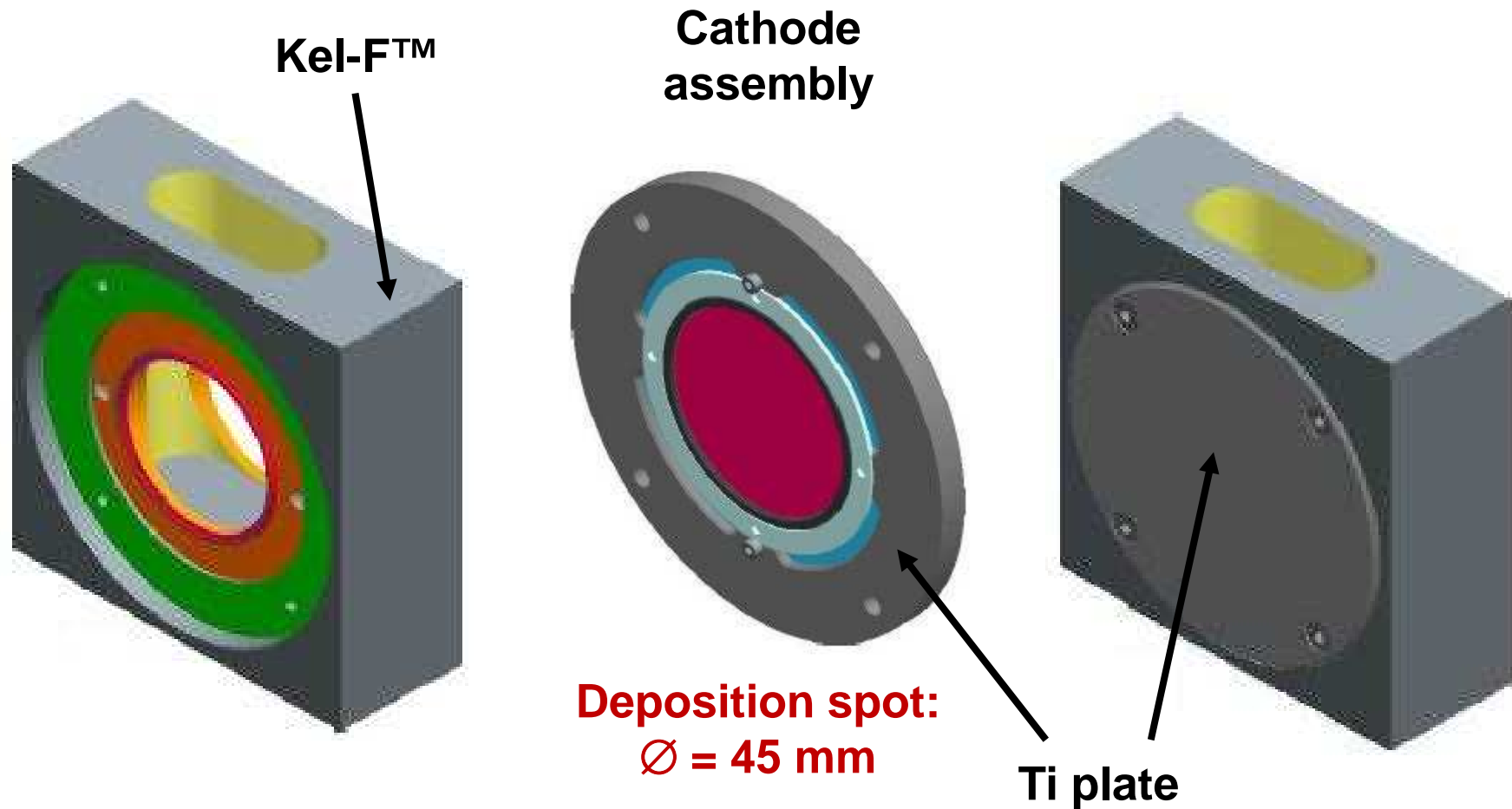
Al-backing (10 μm)
Ti-Coating (50 nm)

Al-ring with holes
for assembly



Carlos Guerrero: *New capture cross sections of ^{242}Pu for MoX fuel reactors* \Rightarrow **Tuesday 16:00**

Electrochemical cell for Molecular Plating



Deposition of Pu by Molecular Plating



Evaporate Pu-solution to dryness in a Teflon beaker



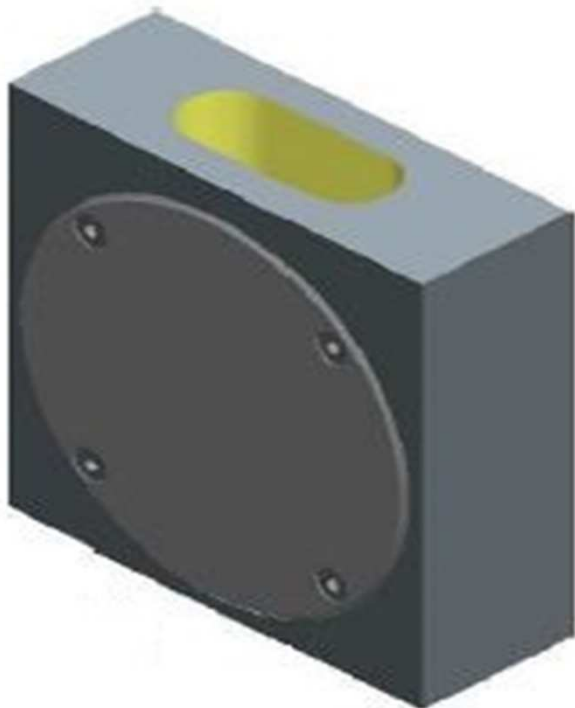
Re-dissolve residue in 2 x 100 μ L 0.1 M HNO_3 and transfer it to the plating cell



Wash teflon beaker with 1 mL isopropanol and transfer it to the cell



Fill the cell with 9 mL isopropanol and 67 mL isobutanol



Deposition of Pu

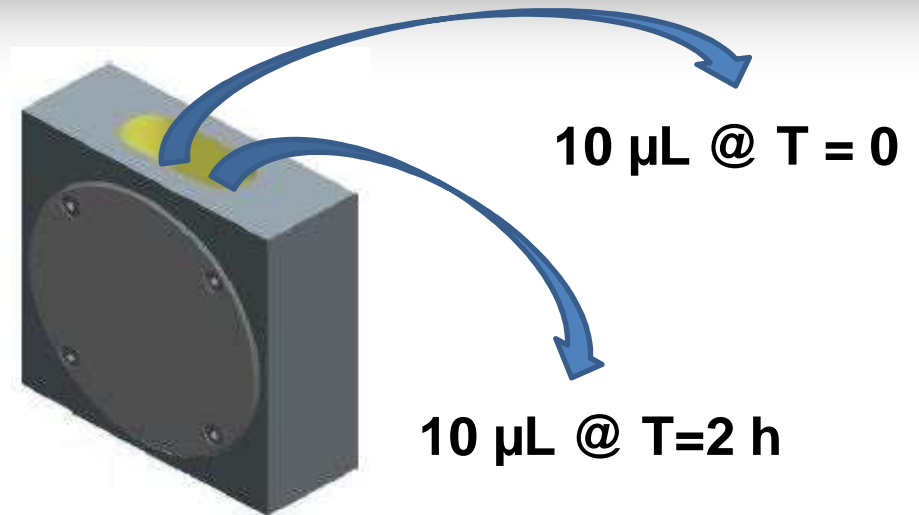
- Current: 15 mA (constant)
- Voltage: 300-400 V (floating)
- Deposition time: 2 hours

Target #	Deposition yield [%]	²⁴² Pu-content [mg]	Layer thickness [$\mu\text{g}/\text{cm}^2$]
1	98	13.4	842
2	98	13.1	826
3	98	14.3	896
4	97	15.1	947
5	99	14.7	923
6	98	15.5	976
7	99	8.9	562

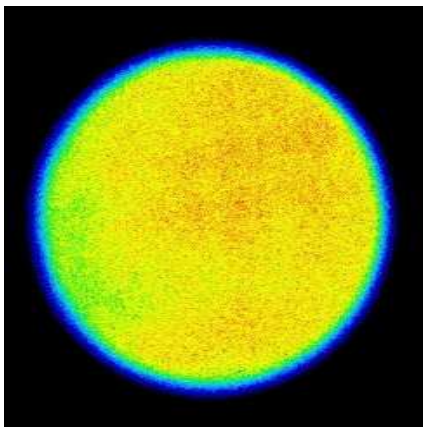
Target characterization

Layer thickness determined by α -particle counting:

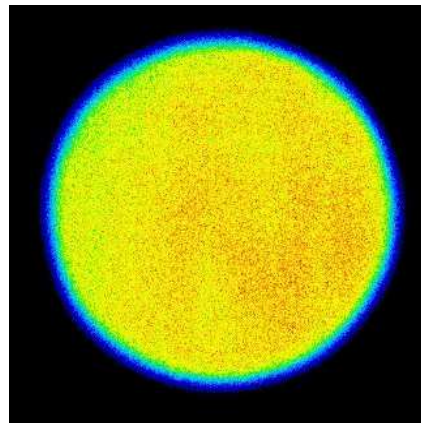
10 μ L samples taken from the supernatant solution prior to and subsequent to deposition



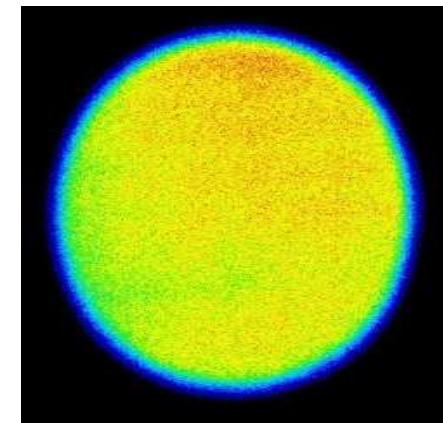
Layer homogeneity checked by Radiographic Imaging (RI)



Target # 2

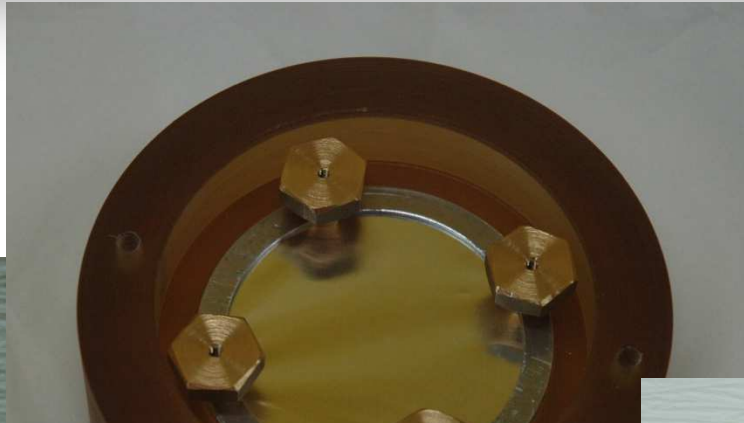


Target # 4



Target # 5

^{242}Pu -targets for CERN / n_TOF



- Dissolution of enriched ^{242}Pu -oxide in a mixture of HNO_3 and HF
- Separation of ^{241}Am by ion chromatography
- Production of targets by **Molecular Plating**
- High deposition yield (exceeding **95%**)
- Good layer homogeneity
- **7 Targets delivered to CERN / n_TOF** for neutron capture cross section measurements