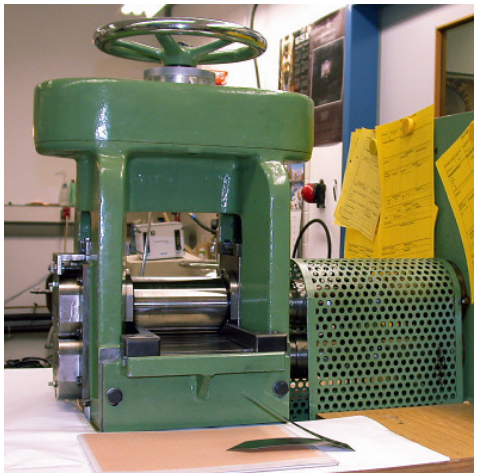
TASCA Target Group – Recent Developments

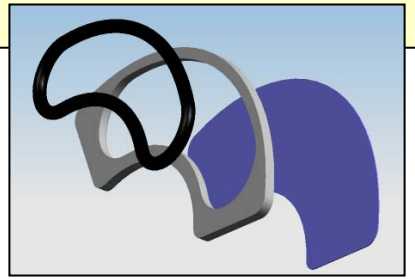
K. Eberhardt for the TASCA Target Group

- Target-Backing-Combinations
- In-beam Target Tests
- Electrochemical Deposition

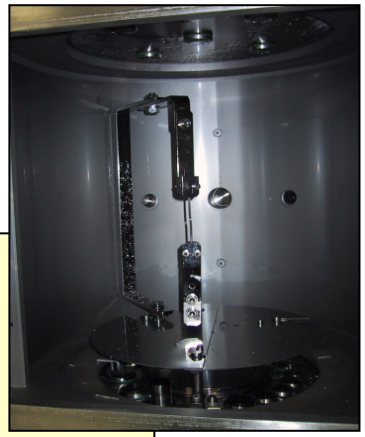
Backing Materials: Be, Al, Ti, C



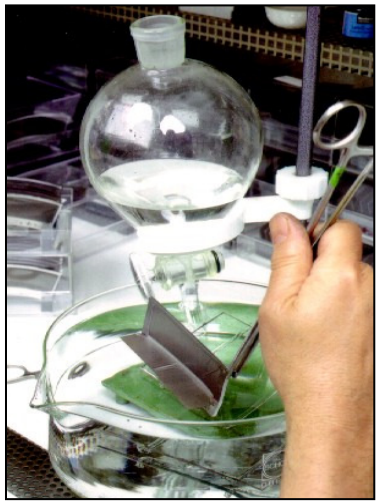
- Thickness range (Be, Al, Ti): 2-10 µm
- Be: Commercially available
- Al, Ti: Produced by cold rolling and glued to frame (AlMg3)



GSI



- C: Evaporation on betain-saccharose on glass carrier plate. Thicknesses: 43-50 µg/cm²



REC SEP @ SHE CHEM

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Target-Backing Combinations

- Target material: UF_4 (350-450 µg/cm²) by evaporation and U (360-420 µg/cm²) by sputtering
- Backing: Al, Ti, C
- Covering layer: C (10 µg/cm², by evaporation)

Sputter target: Depleted ^{nat}U

^{235}U < 0.2 %

Ø = 1 "

d = 3 mm

m ~ 30 g

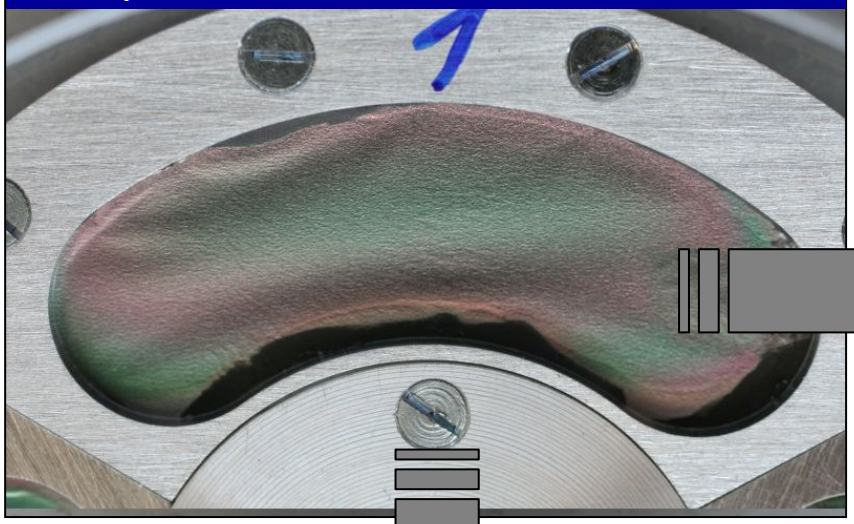
GSI

REC SEP @ SHE CHEM

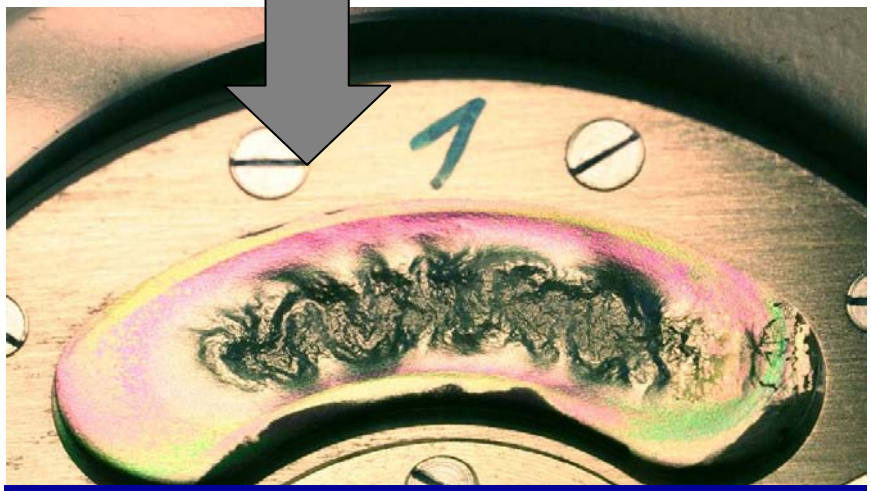
JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Target Tests: ^{12}C- beam / ^{26}Mg-beam on Al/UF_4

UF_4 on Al, unirradiated



UF_4 on Al after 0.5 pμA ^{12}C



UF_4 on Al after 1pμA ^{26}Mg

Target with Al-backing destroyed by Mg-beam.

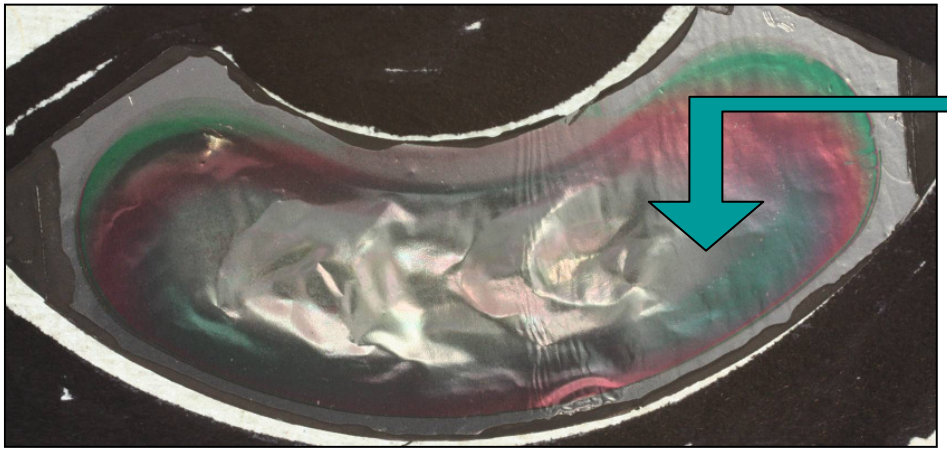
⇒ Ti and C as Backing?

REC SEP @ SHE CHEM

GSI

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Target Tests: ^{40}Ar-beam on different backings



0.4 pμA on Al/UF4 wavy
0.4 pμA on Al unchanged
0.4 pμA on Ti unchanged
tarnished colours

0.8 pμA on Al little wavy
0.8 pμA on Ti unchanged
tarnished colours
0.8 pμA on C destroyed
(non heated)

0.8 pμA on ~10 μm Al holey
0.8 pμA on ~2.5 Al unchanged

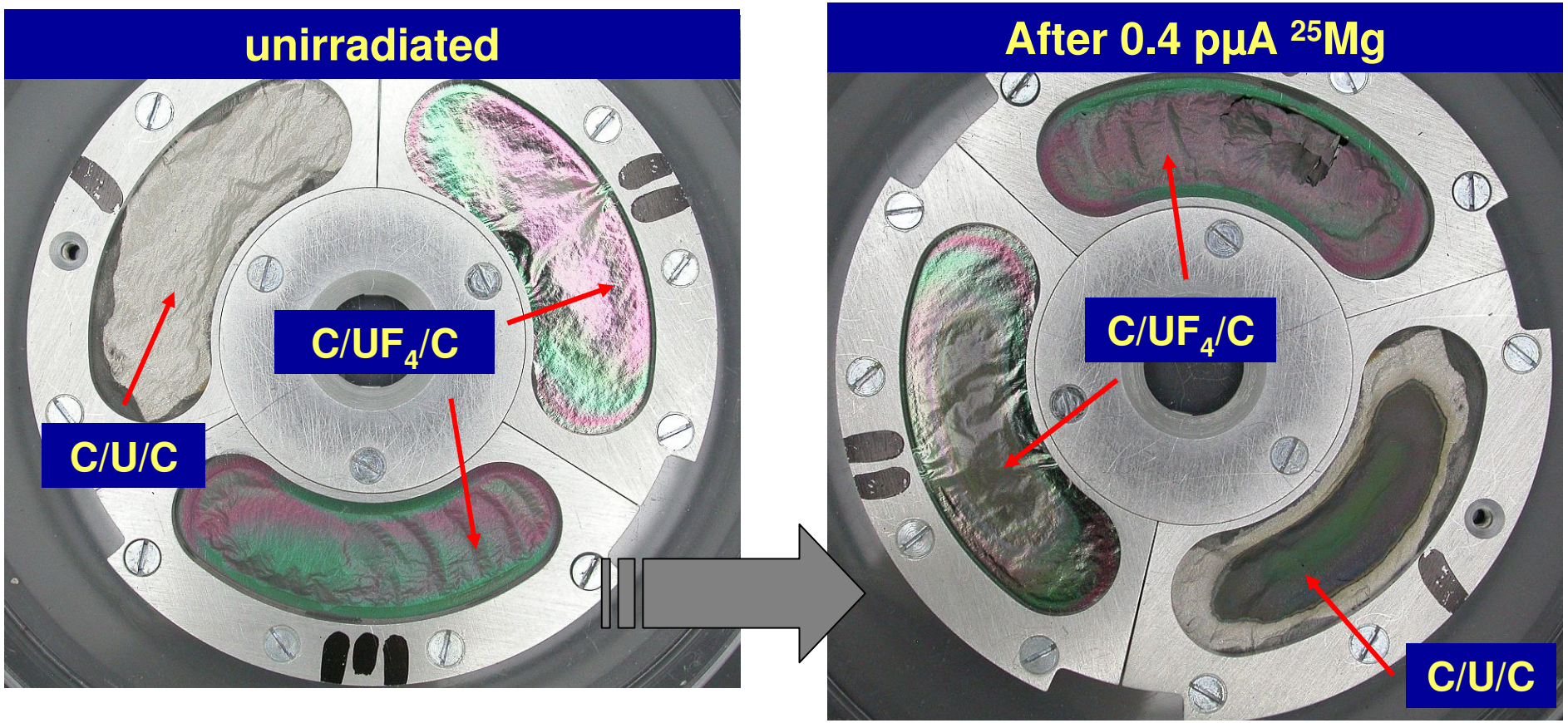
Irradiation tests only with backing not sufficient

REC SEP @ SHE CHEM

GSI

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Target Tests: ^{26}Mg-beam on C/U/C + C/UF_4/C



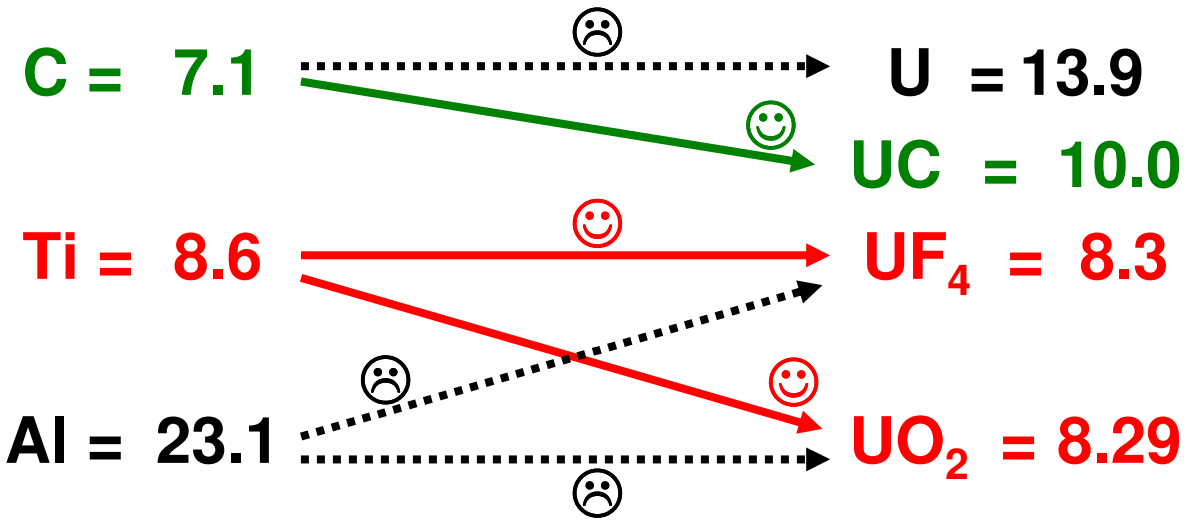
C/U/C more stable than C/UF_4/C

⇒ Ti as backing material?

Thermal Expansion of Backing and Target Materials

Thermal expansion coefficient at room temperature given in [µm/(m·K)] = 10^{-6} [1/K]

Backing materials	Target materials



Handbook of Physics and Chemistry, 85th edition

Gmelin, Uranium compounds

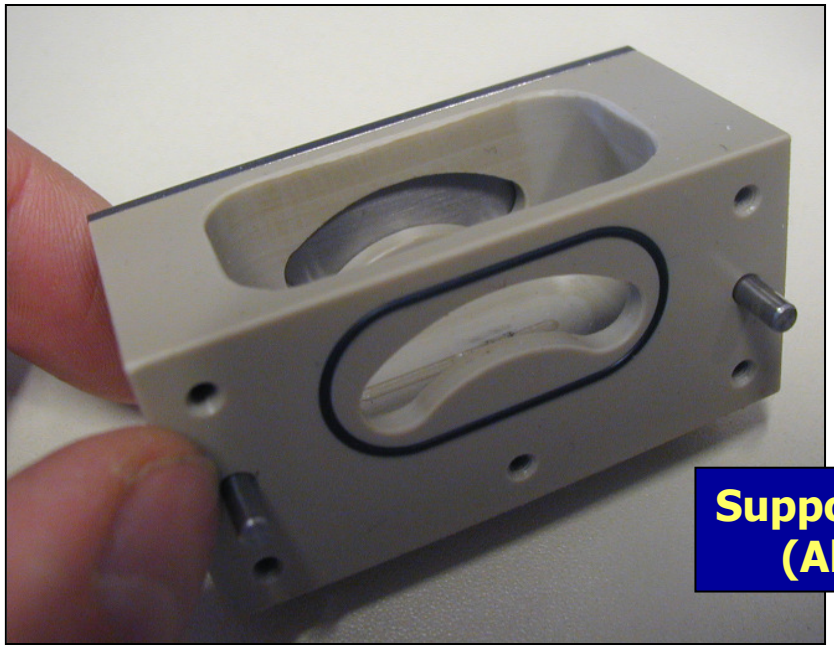
Future Target Tests (Beam Time November 2006)

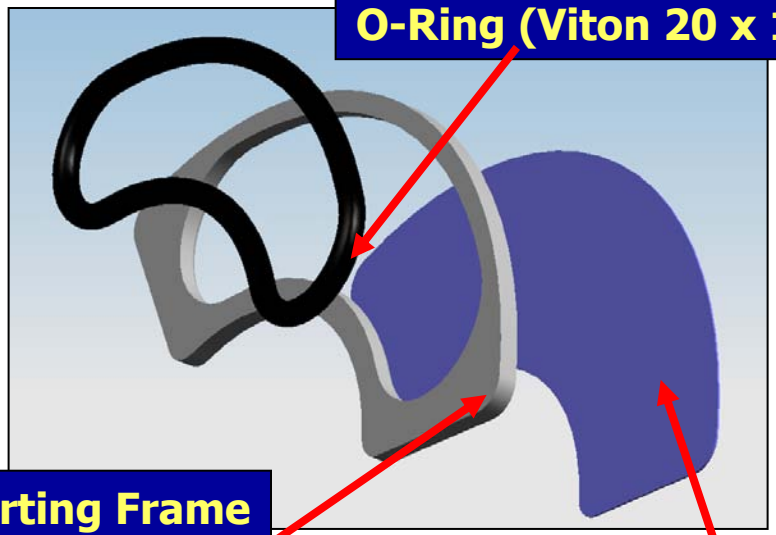
C/U/C	40 µg/cm² / 400 µg/cm² / 10 µg/cm²
Ti/U/C	2 µm / 400 µg/cm² / 10 µg/cm²
Ti/U	2 µm / 400 µg/cm²
Ti/^{144}Sm	2 µm / 100 µg/cm²
Ti/^{144}Sm	2 µm / 450 µg/cm²
Ti/^{144}Sm	2 µm / 800 µg/cm²
Ti/^{154}Sm	2 µm / 450 µg/cm²
Ti/ ^{nat}Gd	4 µm / 470 µg/cm²
C/^{208}PbS/C	40 µg/cm² / 470 µg/cm² / 10 µg/cm²

REC SEP @ SHE CHEM

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Electrochemical Deposition – New Plating Cell





- Material: PEEK
- Volume: about 16 ml
- Horizontal gaps for electrodes
- Uniform electrical field
- Water-cooled Ti-blocks as electrodes (not shown)

Deposition conditions:

Plating time……5 h
Voltage……150 V
Current……100 – 800 µA
Stirring at……1000 U/min
Temperature…..15-25 °C

Cell design according to H. Haba [RIKEN], TASCA05, Oslo, Oct. 2005

Targets Produced

Element	Backing	Amount [µg]	Thickness [µg/cm²]
Ho	Al	2000	460
Ho	Al	2000	673
Ho	Al	2000	517
Ho	Al	2000	856
Ho	Al	2000	896
Ho	Al	2000	528
Ho	Ti	2000	666
Ho	Ti	2000	517
Ho	Ti	2000	379
Ho	Ti	2000	862
Ho	Ti	2000	701
Ho	Ti	1000	570
Ho	Ti	1000	557
Ho	Ti	1000	568
Ho	Ti	1000	565
Ho	Ti	1000	528
Gd	Ti	1000	517
Gd	Ti	1000	560
Gd	Ti	1000	560
Gd	Ti	1000	557
Gd	Ti	1000	548

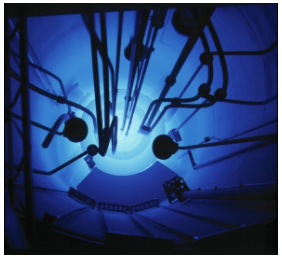
Element	Backing	Amount [µg]	Thickness [µg/cm²]
Sm	Al	2000	970
Sm	Ti	1000	546
Sm	Al	1000	501
Sm	Al	500	273
Sm	Ti	500	286
Sm	Ti	1500	814
Sm	Al	1500	743
Sm	Al	500	278
Sm	Ti	500	279
Sm	Ti	500	274
Sm	Al	500	258
Sm	Ti	1000	543
Sm	Ti	1000	548
Sm/U	Ti	500 Sm / 500 U	230 Sm / 203 U
Sm/U	Ti	500 Sm / 500 U	245 Sm / 227 U

- **Systematic studies**
- **TASCA-Commissioning Experiment May 2006**

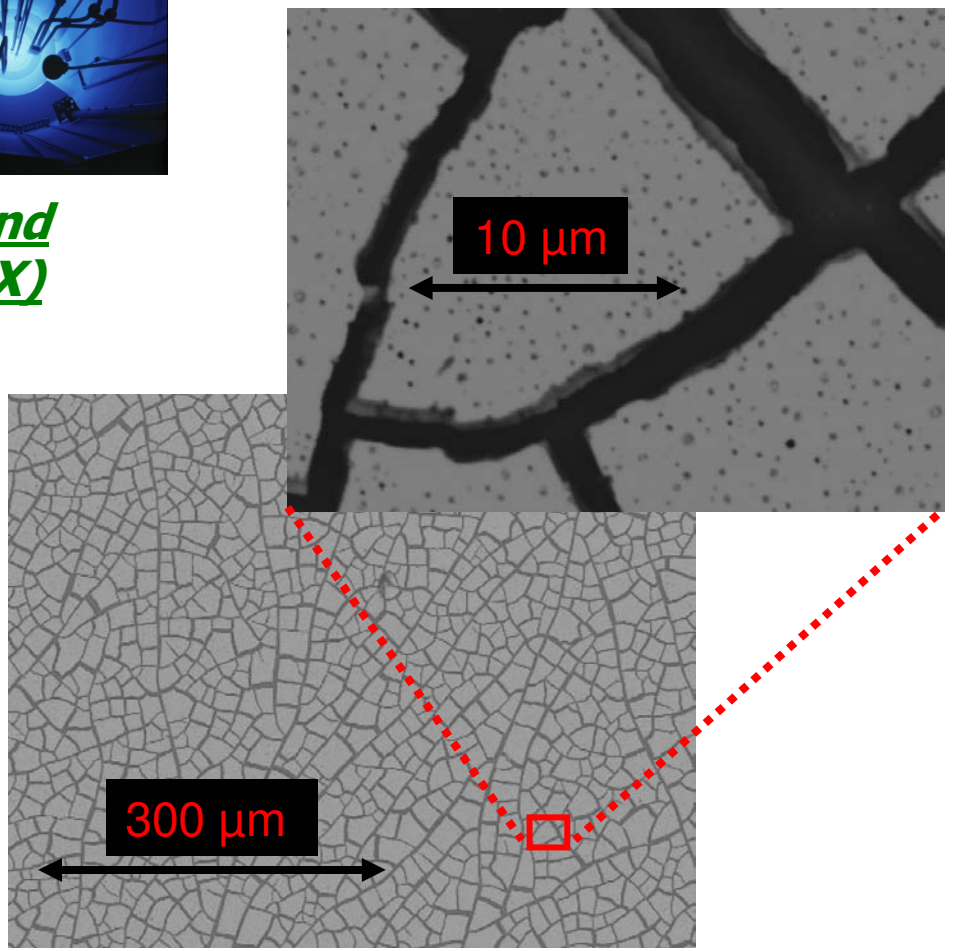
JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Investigation of the Deposited Layer

Neutron Activation Analysis (NAA) **for yield determination**

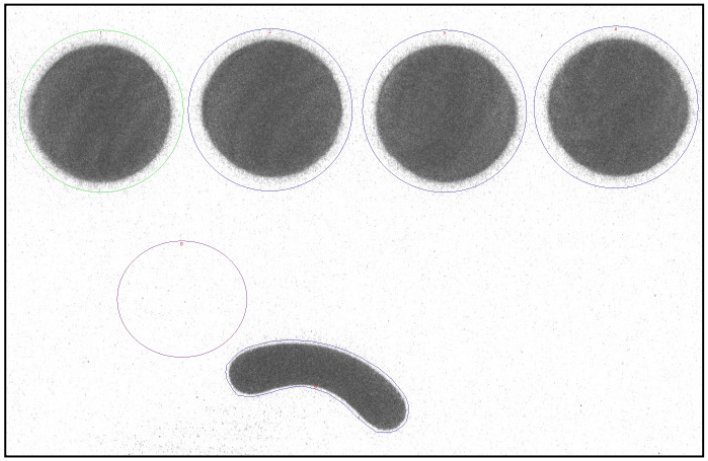


Scannin Electron Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDX) **for microstructural analysis**



SEM of U-target (~ 380 µg/cm^2)

Radiographic Imaging (RI) **for yield determination and homogeneity check**



RI of U-targets (~ 400 µg/cm^2)

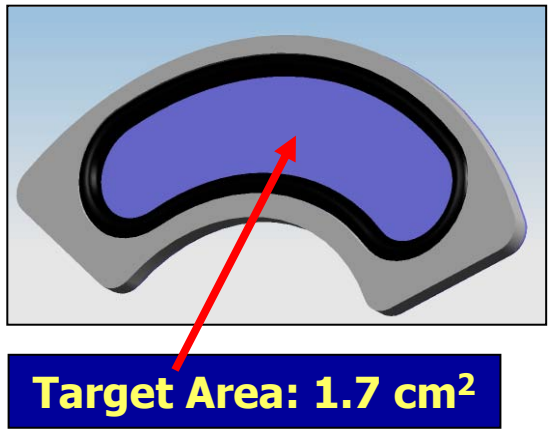
Optimizing the Plating Conditions

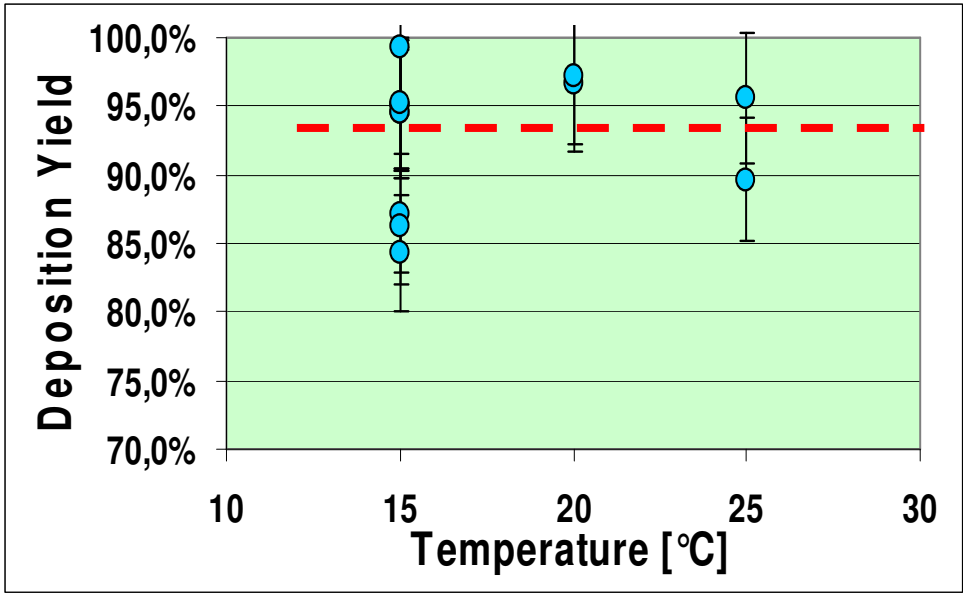
Deposition yield as a function of temperature:

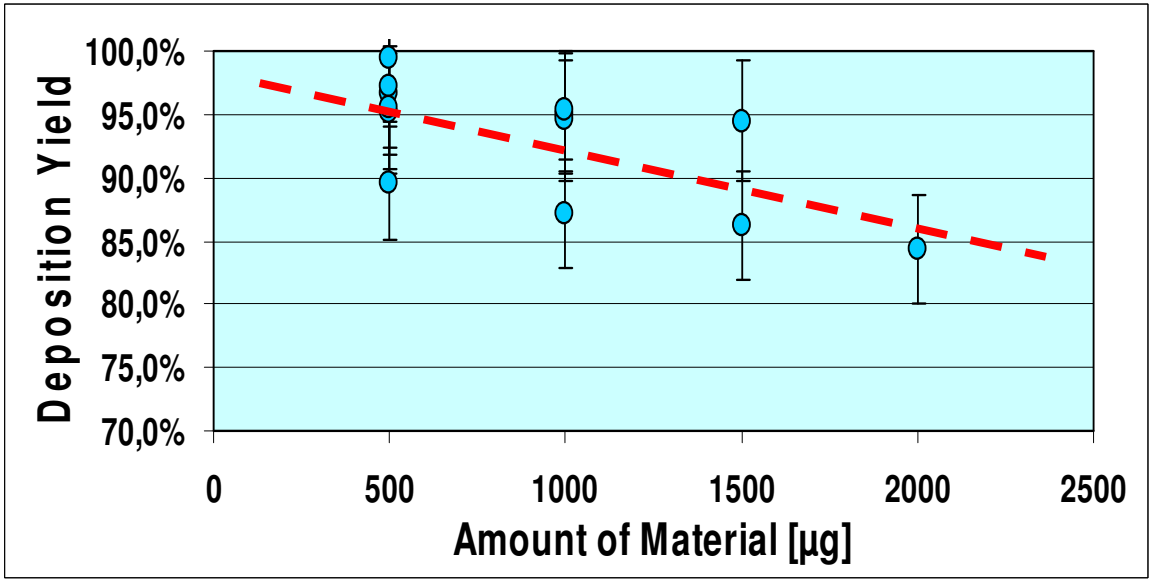
- Yield ≥ 85%
- No correlation observed

Deposition as a function of the initial amount of material:

- Yield ≥ 85%
- Yield decreases with initial mass







REC SEP @ SHE CHEM

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Electrodeposition – Future Investigations

Electrodeposition of other target materials:

Lanthanides + Th, Pu, Cm +……..

Scannin Electron Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDX):

for studies of microstructure and elemental distribution in "mixed" lanthanide/actinide targets

Radiographic Imaging (RI):

for yield determination and homogeneity check

REC SEP @ SHE CHEM

JOHANNES GUTENBERG UNIVERSITÄT MAINZ