University of Munich Hot-Lab Facility

1972 – today: Fabrication of Radioactive Targets for Nuclear Accelarator Experiments

Nuclides so far processed:

Actinides: 
- $^{227}$Ac
- $^{230,232}$Th
- $^{231}$Pa
- $^{233,234,235,236,238}$U
- $^{237}$Np
- $^{239,240,242,244}$Pu
- $^{241}$Am
- $^{248}$Cm

Other Nuclides: $^{14}$C, $^{129}$J, $^{210}$Pb, $^{226}$Ra

Historical facility development:

1972-1987: Small laboratory with home-made safety equipment, continuously adapted to the growing demands

1987: Shut down on our own initiative

1987-1997: Design and construction of a completely new facility in Cooperation with the Bavarian Ministry of Environmental Affairs

- Up-to-date safety and security standard
- Modern technological equipment for processing and handling of radioactive material

12.12.1997: Commissioning of the new facility
**Technological Capabilities**

**Processing** of

a) Standard isotopic material

b) Exotic isotopic material

by PVD (Physical Vapour Deposition)

a) Standard Isotopic material of limited specific activity and sufficient availability:

\[ ^{230,232}\text{Th} \]
\[ ^{231}\text{Pa} \]
\[ ^{233,234,235,236,238}\text{U} \]
\[ ^{237}\text{Np} \]
\[ ^{239,240,242}\text{Pu} \]
\[ ^{241,243}\text{Am} \]

**Glovebox 1:**

Permanently installed, cryopumped stainless steel vacuum evaporation chamber, 250 l volume, working pressure $10^{-7}$ mbar

**Equipment:**

- 2 cold crucible e-guns and 1 resistive heater
- 2 independent quartz crystal oscillators
- Remote-controlled substrate positioning mechanism

**Technological capabilities:**

- Production of high-quality thin film targets
- Vacuum-metallurgical procedures (refining, alloying, and annealing of metals
## Standard Target Performance

<table>
<thead>
<tr>
<th><strong>Morphology:</strong></th>
<th>Target films of high density and smoothness, well suited for high resolution particle and fission fragment spectroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum target thickness:</strong></td>
<td>500-1000 ( \mu g \ cm^{-2} )</td>
</tr>
<tr>
<td><strong>Backing:</strong></td>
<td>Typically 5-40 ( \mu g \ cm^{-2} ) C foil</td>
</tr>
<tr>
<td><strong>Chemical form of target film:</strong></td>
<td>Actinide oxide (most stable compound)</td>
</tr>
<tr>
<td><strong>Protective layer:</strong></td>
<td>10 ( \mu g \ cm^{-2} ) C (if requested)</td>
</tr>
<tr>
<td><strong>Target size:</strong></td>
<td>Typically 1 cm(^2), maximum 5x10 cm(^2)</td>
</tr>
<tr>
<td><strong>Thickness variation across the target:</strong></td>
<td>Typically 5 %, in special cases ( \leq 1 % )</td>
</tr>
<tr>
<td><strong>Isotopic material consumption:</strong></td>
<td>Minimum 1 mg for 10 ( \mu g \ cm^{-2} ) film thickness</td>
</tr>
</tbody>
</table>
b) Exotic isotopic material of high specific activity or limited availability:

**Requirements:** Processing of submilligram-quantities of material

<table>
<thead>
<tr>
<th>Isotope</th>
<th>$^{210}$Pb</th>
<th>$^{226}$Ra</th>
<th>$^{227}$Ac</th>
<th>$^{229}$Th</th>
<th>$^{244}$Pu</th>
<th>$^{248}$Cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bq/mg</td>
<td>2.83E9</td>
<td>3.70E7</td>
<td>2.68E9</td>
<td>7.88E6</td>
<td>6.80E2</td>
<td>1.57E5</td>
</tr>
</tbody>
</table>

**Glovebox 3:**

Small, replaceable, cryopumped stainl. steel vacuum chamber, working pressure $10^{-7}$ mbar

**Equipment:** Custom-designed micro-evaporation setup

**Technological capabilities:**

High material-economy thin film target preparation
**Exotic Target Performance**

**Morphology:**
Target films of high density and smoothness, well suited for high-resolution particle- and fission fragment spectroscopy.

**Maximum target thickness:**
500-800 µg/cm²

**Backing:**
Typically 15-40 µg/cm² C foil

**Chemical form of target film:**
Metal, oxide, or halide (depending on specific material)

**Protective layer:**
10 µg/cm² C (if requested)

**Target spot size:**
Typically 3-5 mm diam.

**Thickness variation across the target:**
5-20 % (depending on specific setup)

**Isotopic material consumption:**
Minimum 40 µg for 100 µg/cm² average film thickness