PAUL SCHERRER INSTITUT

PSI

Preparation of radioactive sources for activity measurements with Magnetic Metallic Calorimeters

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The ERAWAST project

ERAWAST:

Exotic **R**adionuclides from **A**ccelerator **WA**ste for **S**cience and **T**echnology

https://www.psi.ch/en/lrc/erawast

➢ **GOALS**

- Separate exotic radioactive lanthanides from radioactive waste
- Measure their half-lives (nuclear property)
- Recovery of exotic radio-lanthanides for future projects and collaborations

➢ **METHODS**

- Extraction *via* chemical techniques: ion exchange, liquid-liquid separation, etc.
- Optimization of devices and techniques
- Domestic and International collaborations (AHL, PTB, TUD)

Radionuclides of interest: ^{137}La and ^{157}Tb

^{137}La

Half-life (y)	Reference
>400	J.B. Chubbock et al., 1948
$(6 \pm 2)\cdot 10^4$	A.R. Brosi et al., 1956

PURE ELECTRON CAPTURE DECAY MODE!

^{157}Tb

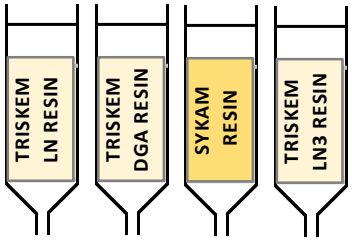
Half-life (y)	Reference
280 ± 120	E.P. Grigorev et al., 1964
160 ± 40	S. Iwata et al., 1963
150 ± 30	I. Fujiwara et al., 1964
99 ± 10	G.J. Beyer et al., 1983
71 ± 7	N. Nica, 2016 Calculated from Beyer et al., 1983

From Waste to Scientific Information

Irradiated Ta samples (waste)

Lns extraction from Ta matrix

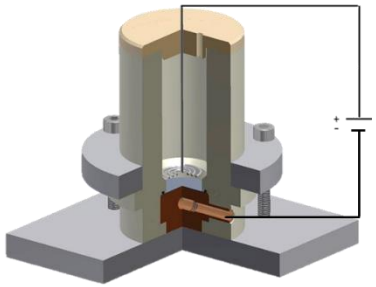
Lns separation



Lns of interest: ^{137}La, ^{157}Tb

ICP-MS
MC-ICP-MS

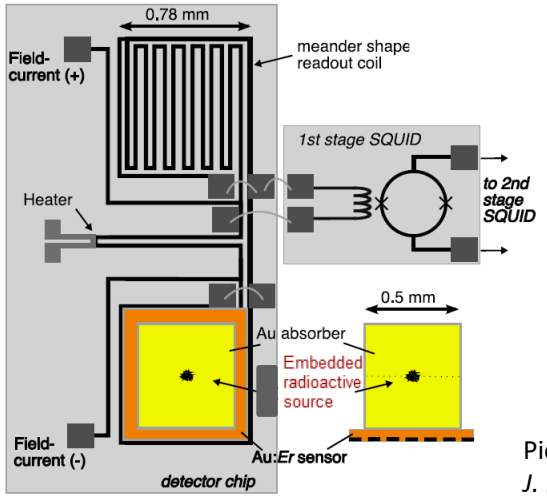
Source preparation



Activity measurement

Half-life determination

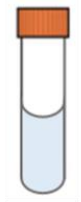
Source preparation for MMC detectors



Goal: produce radioactive sources of **^{137}La and ^{157}Tb fully embedded in a metal matrix** (Au, Pd, Rh, etc.) for activity measurements with MMC detectors.

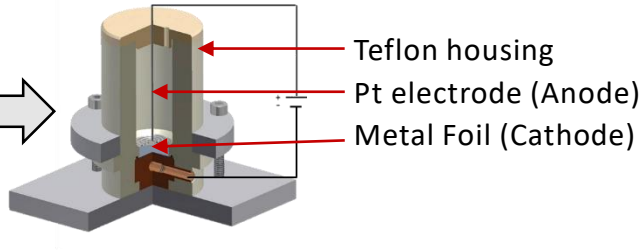
Picture adapted from: H. Rotzinger et al., Beta Spectrometry with Magnetic Calorimeters. *J. Low Temp. Phys.* **151**, 1087–1093 (2008).

1) Purification



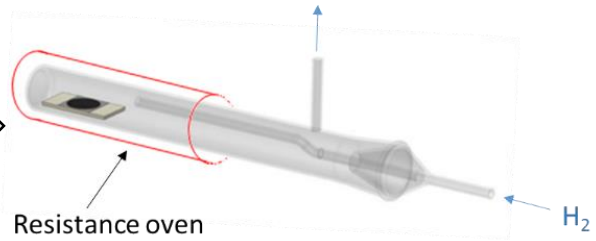
Purified Ln fraction

2) Electrodeposition



Lns electrodeposition on noble metal foil (Au, Pd, Rh, etc)

3) Coupled reduction



Formation of Lns-metal alloys in H_2 at high temperatures