



HAL
open science

Traceable surface sources by functionalization for initial mapping of nuclear facilities

Dilan Tuzun, Valérie Lourenço, Lucille Chambon, Yann Kergadallan

► To cite this version:

Dilan Tuzun, Valérie Lourenço, Lucille Chambon, Yann Kergadallan. Traceable surface sources by functionalization for initial mapping of nuclear facilities. ANIMMA 2023 - The 8th International Conference on Advancements in Nuclear Instrumentation Measurement Methods and their Applications, Jun 2023, Lucca, Italy. , 2023. cea-04155149

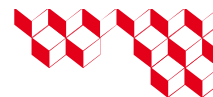
HAL Id: cea-04155149

<https://cea.hal.science/cea-04155149v1>

Submitted on 7 Jul 2023

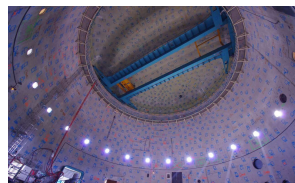
HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Dilan Tüzün, Valérie Lourenço, Lucille Chambon, Yann Kergadallan
 Université Paris-Saclay, CEA, List, LNHB, Saclay, France

Context and Challenges

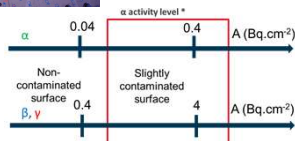
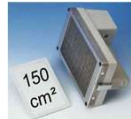


Challenges

- Discrimination between non-contaminated surfaces and **low-level contaminated surfaces**
- Very large areas
- Non-flat surfaces

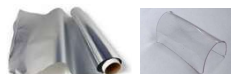


Commercial source



Needs

- Reliable contamination measurements
- Calibration of measurement systems



Aim

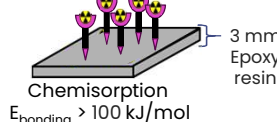
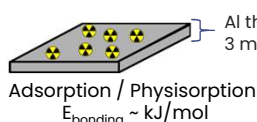
- Traceable activity and emitted flux
- Large surface areas
- Non-contaminating surface (use on-site)
- Complex shapes

Chosen substrates

- Aluminum foil
- Polymeric surfaces**

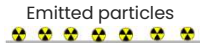
Commercial sources:
RN dried + protected

Our approach: chemical bonds
RN-surface

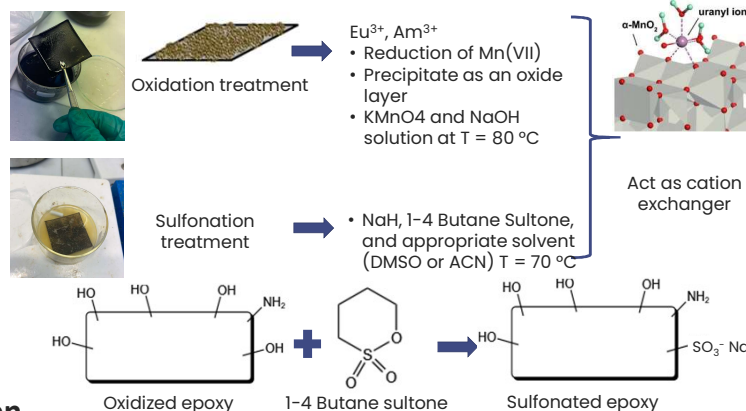
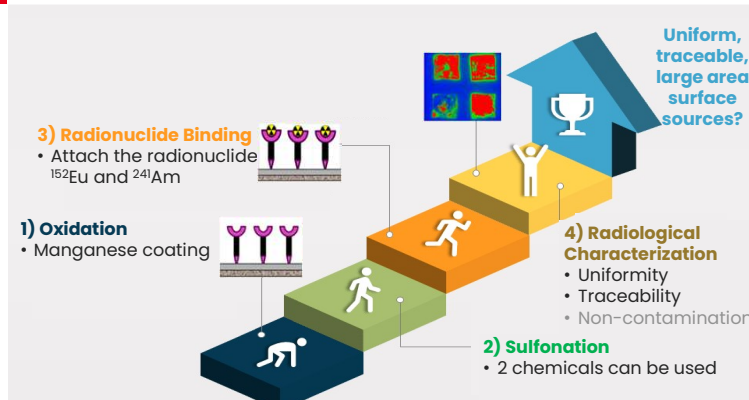


Use of functionalization

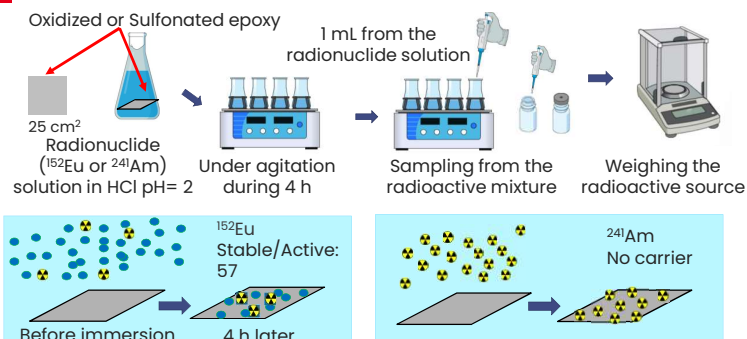
- Strong chemical bonds → **No cover layer**
- Thin sources → **Minimize self-absorption**



Our Approach



Experimental set up & radiological characterization



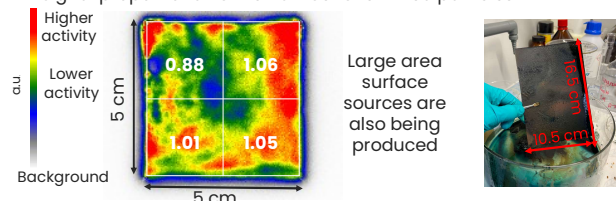
Total amount of element in solution in both cases: ~0.45 picomole

Oxidated Samples	RN	% LSC activity decrease	Max activity bound (Bq/cm²)
Oxidized (E2)	¹⁵² Eu	(83.5 ± 2.7)%	20.0 ± 0.6
Oxidized (F2)	¹⁵² Eu	(98.0 ± 2.9)%	17.0 ± 0.5
Oxidized (G2)	¹⁵² Eu	(96.5 ± 2.8)%	20.5 ± 0.6
Oxidized (J1)	²⁴¹ Am	(95.5 ± 2.8)%	19.0 ± 0.6

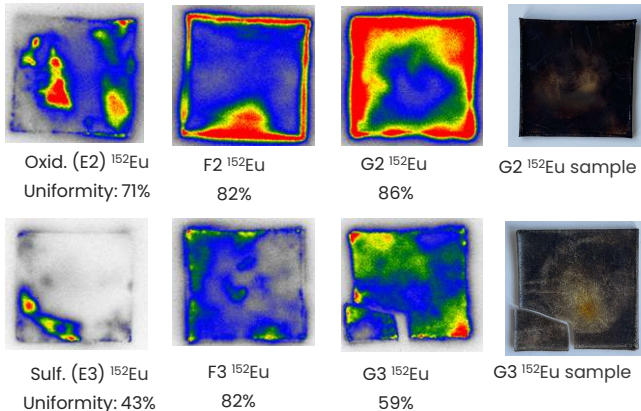
Sulfonated Samples	RN	% LSC activity decrease	Max activity bound (Bq/cm²)
Sulfonated (E3)	¹⁵² Eu	(55.0 ± 2.5)%	12.5 ± 0.6
Sulfonated (F3)	¹⁵² Eu	(87.5 ± 2.7)%	15.5 ± 0.5
Sulfonated (G3)	¹⁵² Eu	(86.0 ± 2.7)%	17.0 ± 0.5
Sulfonated DMSO (H6)	¹⁵² Eu	(76.5 ± 2.6)%	15.5 ± 0.5

Analysis after RN binding: Autoradiography

- Signal proportional to the number of emitted particles



- Oxidized (J1) ²⁴¹Am: Uniformity (St. dev.): 92%



Oxidized samples resulted in higher uniformity

We have produced surface sources with activities ~17 Bq/cm². The surface activity **can be tuned** to meet specific needs. **Reproduce complex shapes including roughness**

Upcoming studies
 • Non-contamination tests
 • ²⁴⁴Cm binding (α)

