New resins and methods for the purification and QC of radionuclides for use in imaging and therapy

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Expertise in Separation Chemistry

Challenges on radionuclide production and research interest

Challenges

- Large excess of matrix (target material)
  - Very high decontamination factors required
- Especially cyclotron produced radionuclides:
  - often quite short half-life of product
- Very high radioactivity levels => increased radiation stability

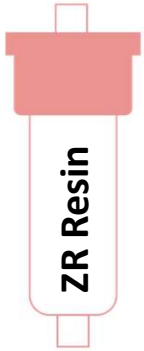
Requirements for resins

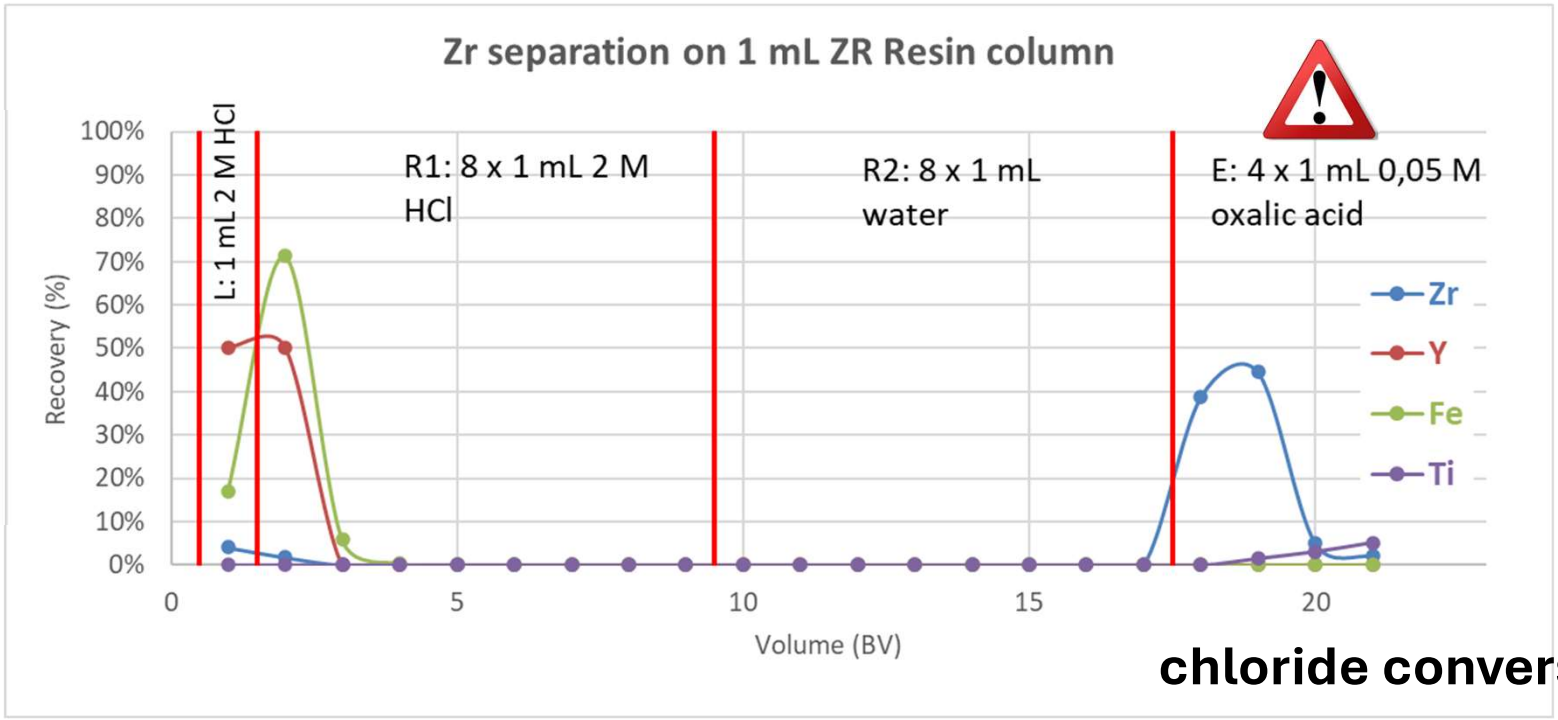
- No selectivity for target material, high selectivity for product
- Fast kinetics
- Elution under ‘soft‘ conditions in small volume

Optimization of ^{89}Zr separation

^{89}Zr ($t_{1/2}$ = 78.41 hours) → immuno-PET

Production via the **^{89}Y(p,n)^{89}Zr** → Existing methods for ^{89}Zr chemical separation

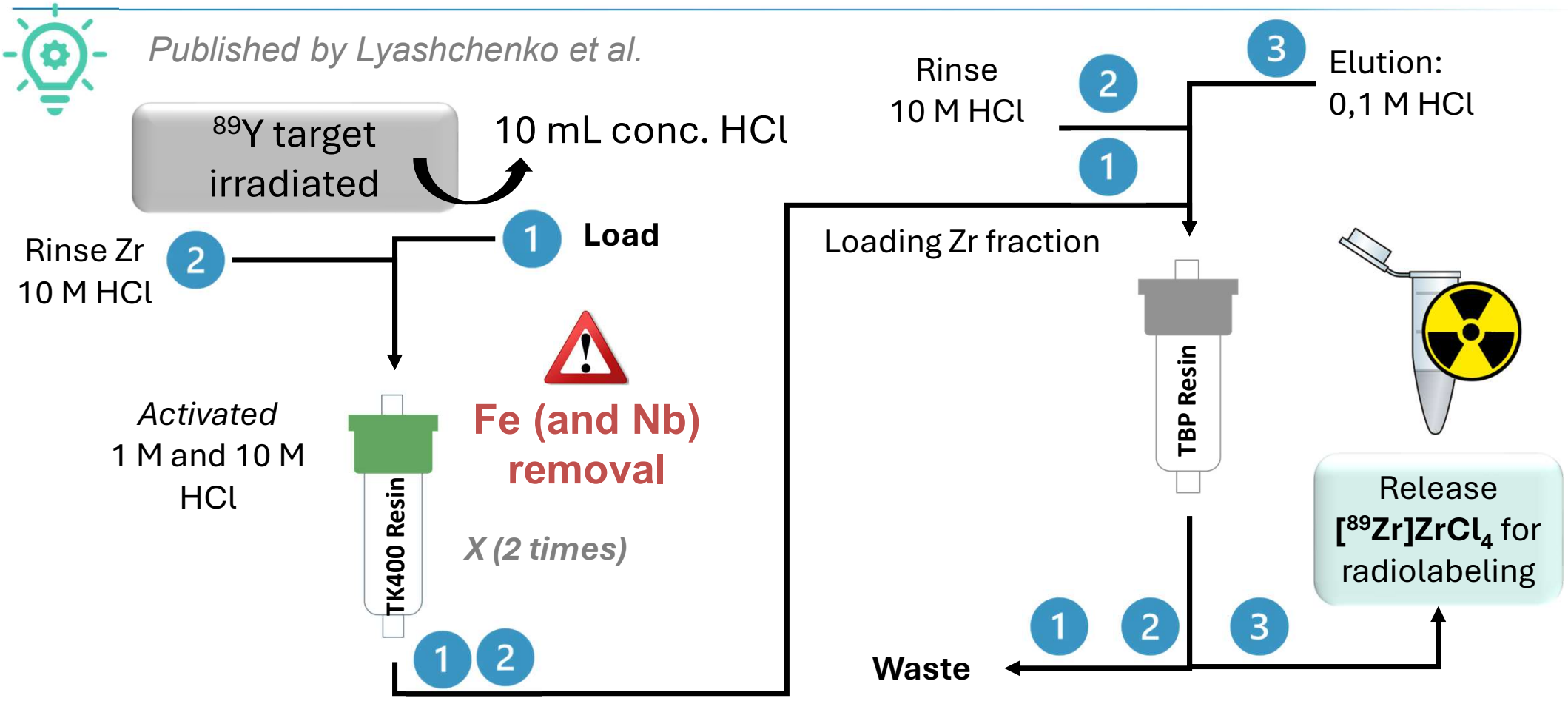




chloride conversions

Optimization of ^{89}Zr separation

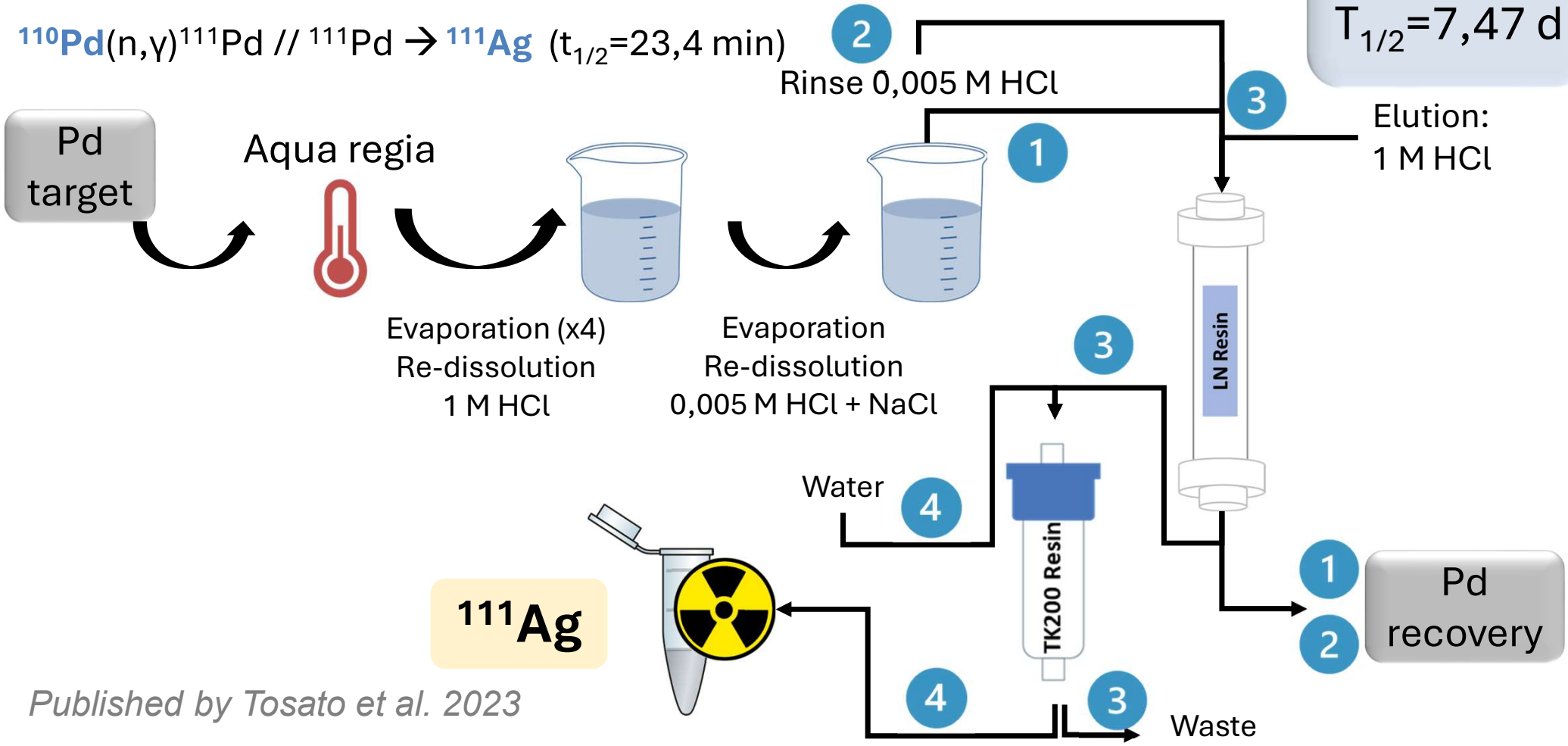
Published by Lyashchenko et al.



Optimization of ^{111}Ag separation

^{111}Ag
$T_{1/2}$=7,47 d

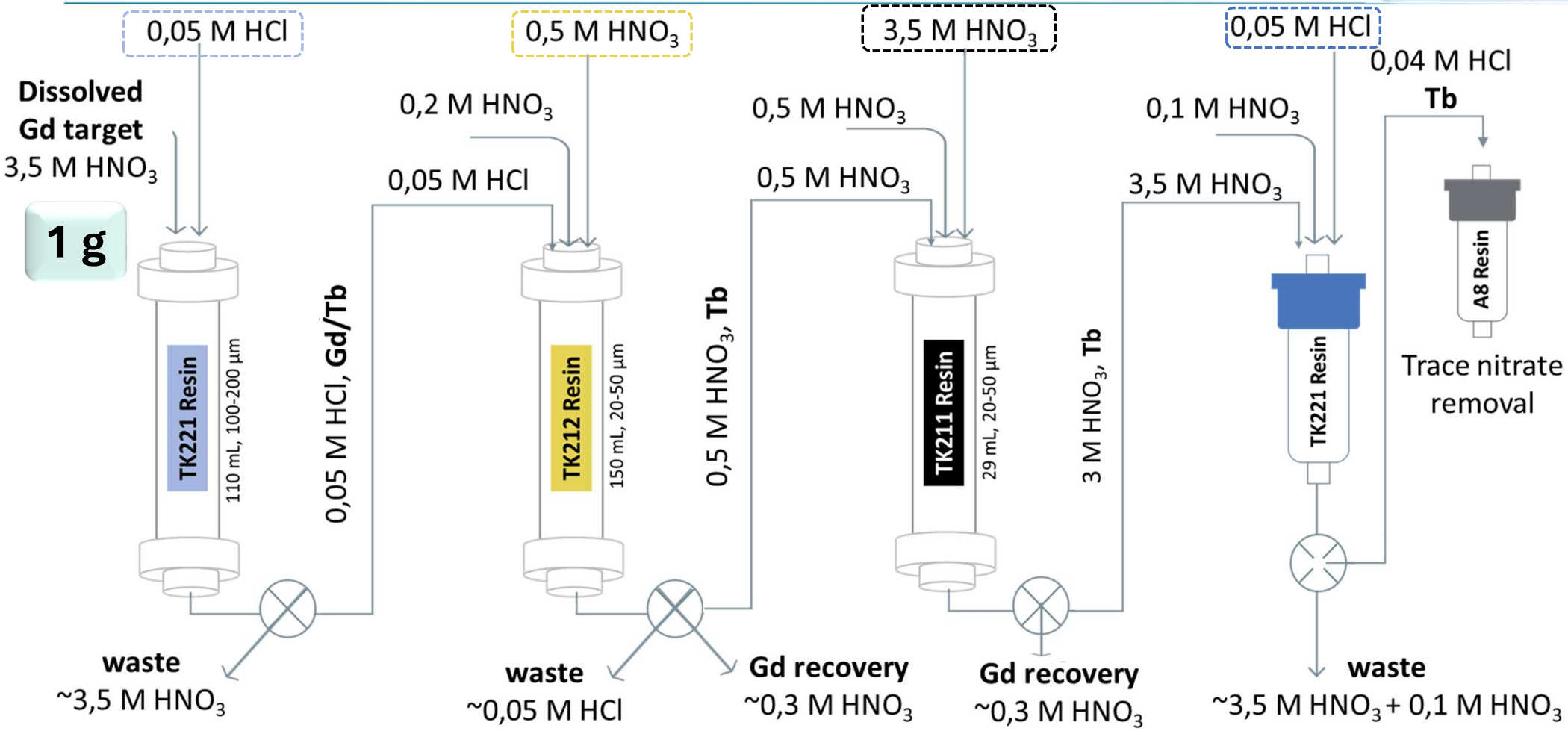
$^{110}Pd(n,\gamma)^{111}Pd$ // $^{111}Pd \rightarrow {}^{111}Ag$ ($t_{1/2}$=23,4 min)



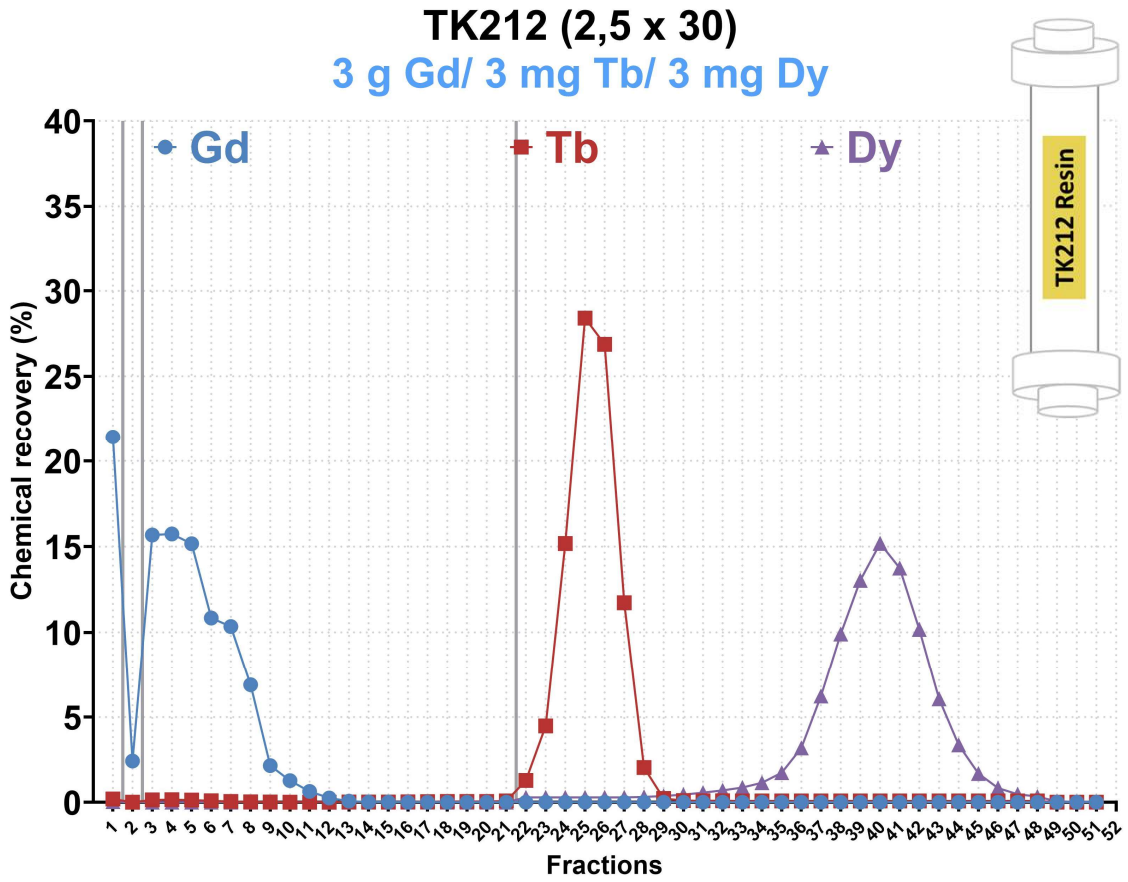
Published by Tosato et al. 2023

Optimization of ^{161}Tb separation

^{161}Tb
$T_{1/2}$=6,9 d



Optimization of ^{161}Tb separation



Gd – earlier elution

3g Gd Gd starts to breakthrough

Small effect on Tb and Dy

Suitable separation Tb/Dy

More than 3 g Gd

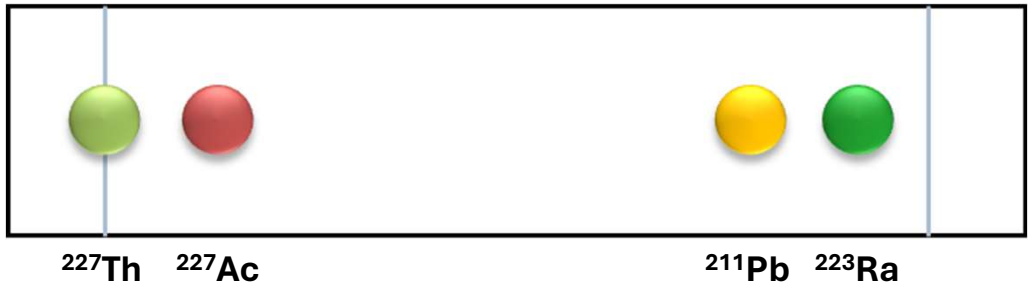
Tb needs to remain on column

Impregnated sheets for QC

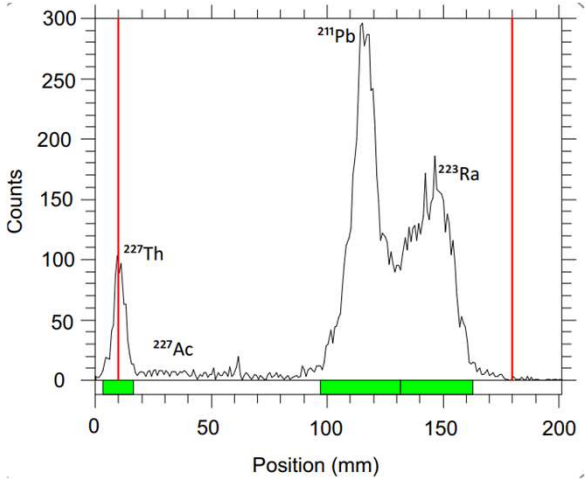
DGA Sheets

- TO-DGA (normal DGA) and TEH-DGA (branched DGA) impregnated TLC paper
- QC of radionuclides and generator eluents
  (e.g. ^{223}Ra, ^{225}Ac/^{213}Bi, ^{212}Pb…)

TLC scanner or radiometer or HPGe after cutting



Chromatographic separation of mixture ^{227}Ac and his daughter's radionuclides



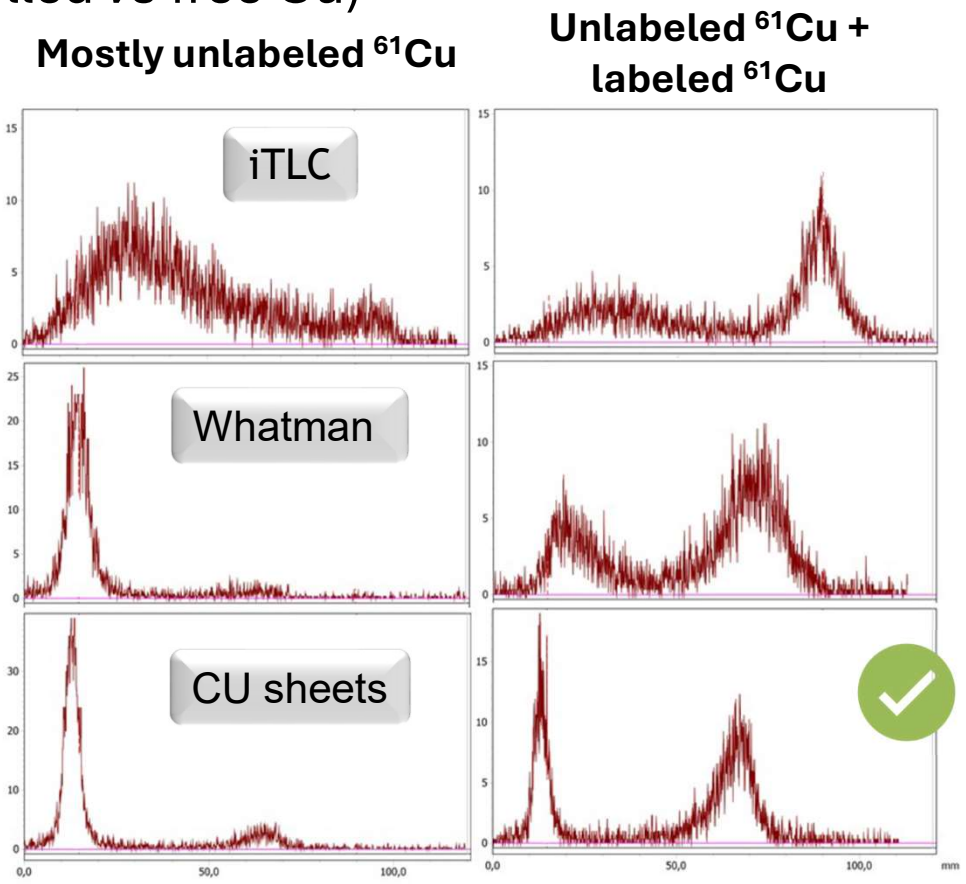
Radiochromatogram measured immediately after separation

Impregnated sheets for QC

CU iSheets

- QC of Cu radiolabelled peptides (labelled *vs* free Cu)
- Extractant used for CU Resin
- ↓ time: iTLC papers / CU sheets (10 min)

Higher resolution

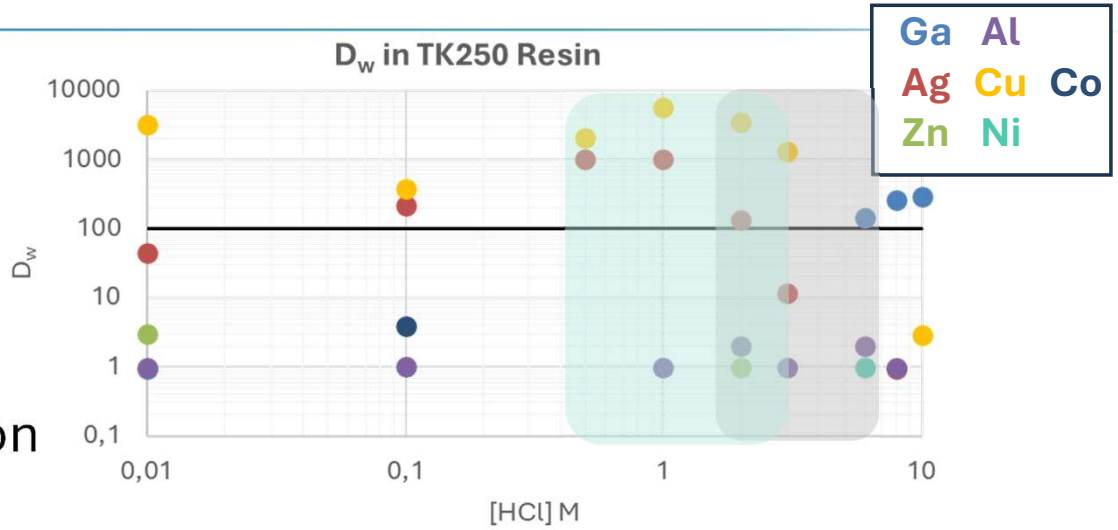


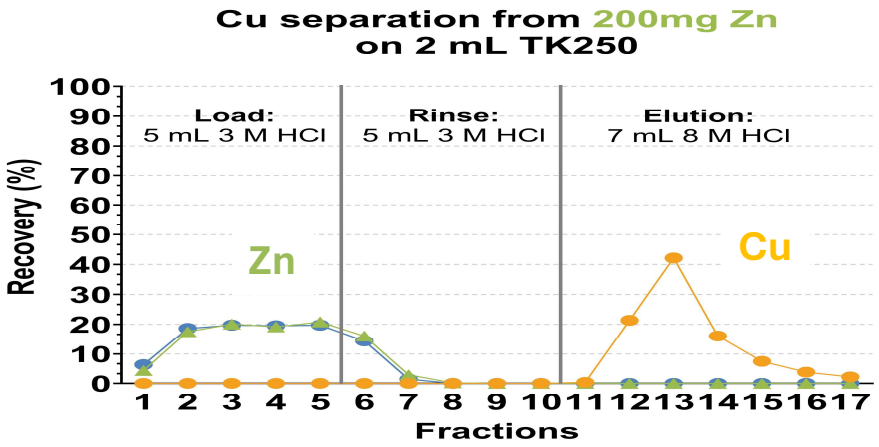
Example

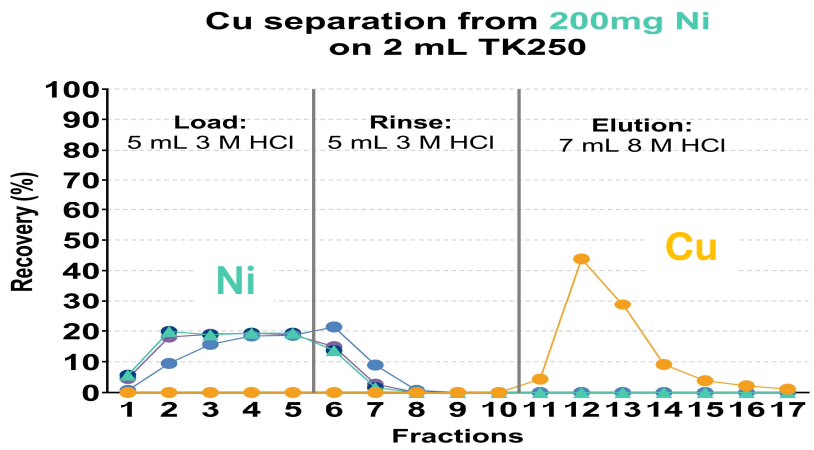
[^{61}Cu]Cu-NOTA-octreotide

Upcoming: TK250 Resin

- Cu retention from elevated [acid]
- Load and rinse at ≤ 3M HCl
- Cu elution in 6 – 8M HCl
  - Ni-64 availability
  - No selectivity for Ni and Zn
  - ➢ Compatible with TK201 for conversion



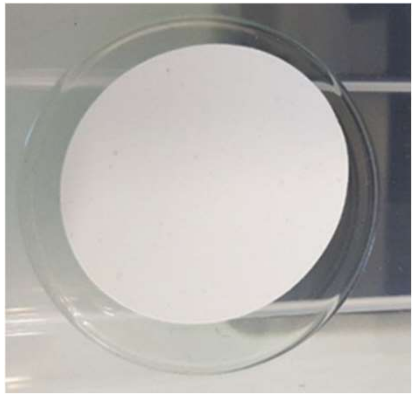




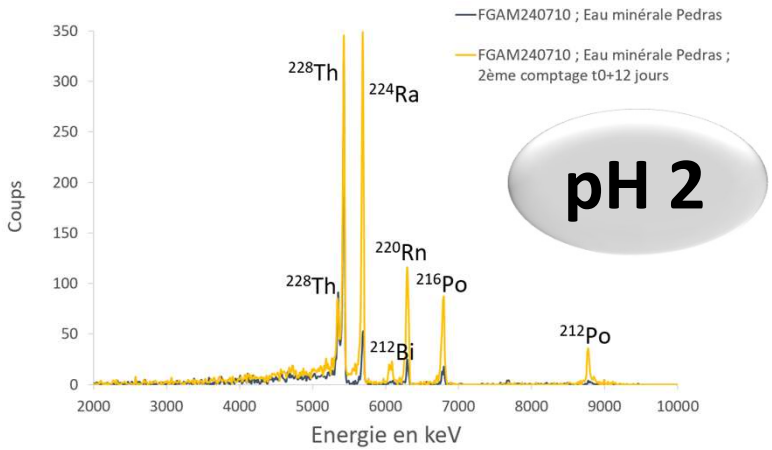
Ongoing research

gross alpha disks (impregnated membrane)

- High retention of actinides
- pH 2, 1-10mL/min, up to 100mL samples
- Size: 47mm and 25mm



rapid QC (Th in Ra solutions)



Radiopharmacy R&D

- Additional ‘disks’ (e.g. TK101)
- Additional ‘iSheets’ (e.g. TK213)
- Upscale of radiolanthanide separations
- At separation
- Meitner-Auger emitters
- Decontamination of effluents and reaction wastes

Thank you for your attention!!

Technical documentation