

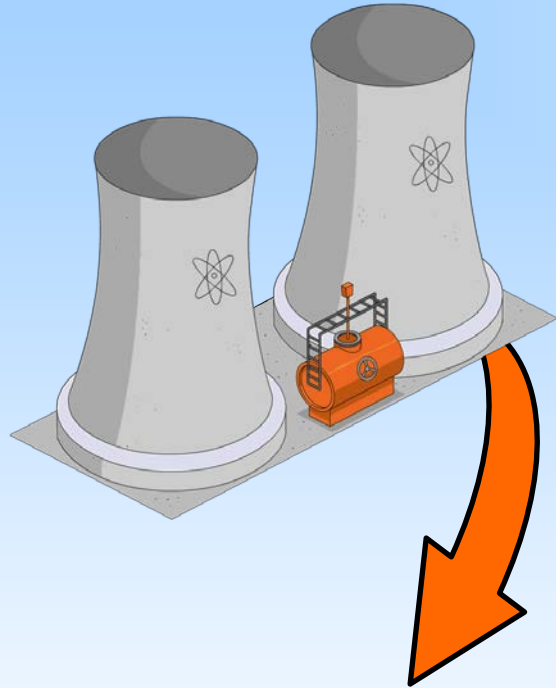
PS resins for the characterization of nuclear wastes: application to ^{126}Sn and ^{63}Ni

Eduard Pelay, Ariadna Ferradal, Ignasi Villarroya, Héctor Bagán,
Alex Tarancón, José F. García



UNIVERSITAT DE
BARCELONA

Introduction



High number of nuclear facilities to be decommissioned

Necessity of new methods

^{126}Sn : fission product



importance in long term storage

^{63}Ni : activation product



high importance in decommissioning

Introduction

- γ emitters easy to determine
 - β and α some challenges
-
- LS common technique for measurement of β emitters
 - Problems of selectivity
- ↓
- chemical separations

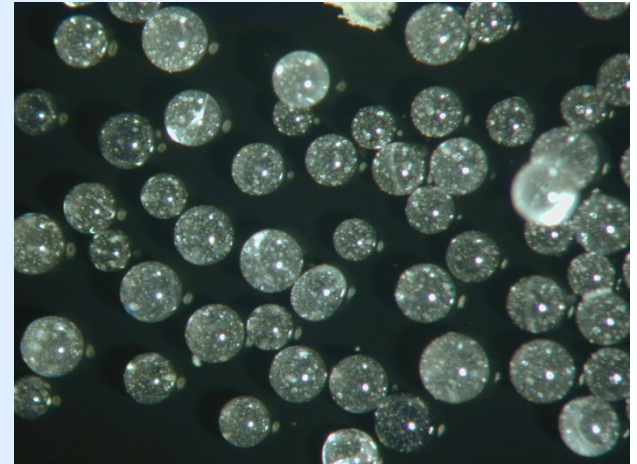


Introduction

PSm

alternative to LS for the measurement of high and medium energy radionuclides

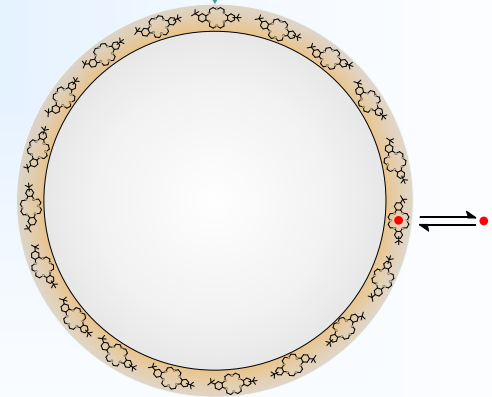
Polymeric support



immobilize
selective extractants

PS resins

unifies separation and measurement in a single step

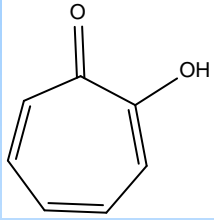


The objective of this study is to develop new PS resin follow new preparation procedures for the analysis of nuclear wastes

Results and discussion

^{126}Sn

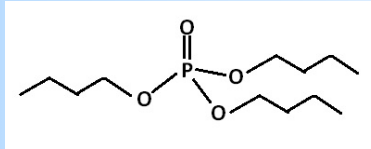
Extractant



Tropolone



Stability problems



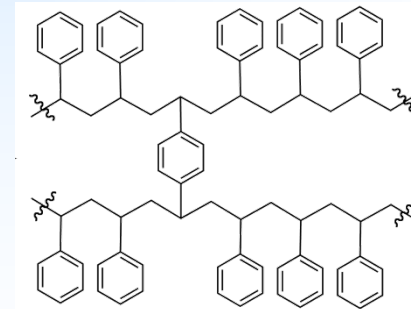
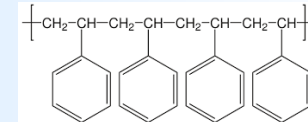
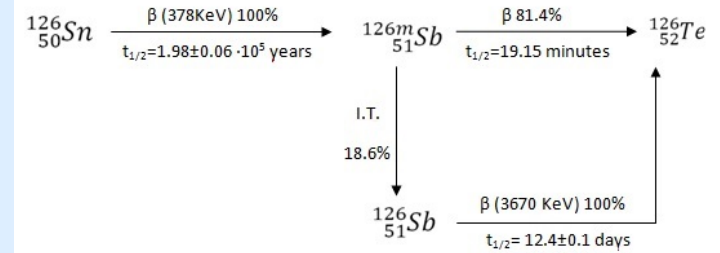
TBP
in n-dodecane



Dissolves PSm

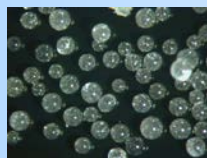


C-PS

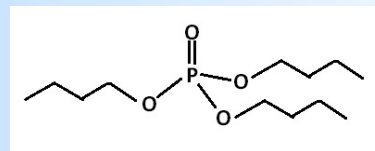


Results and discussion

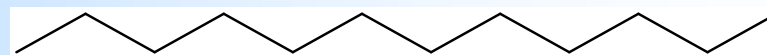
Impregnation



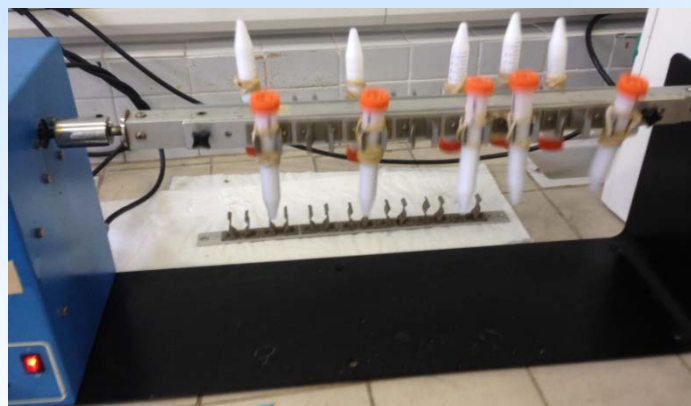
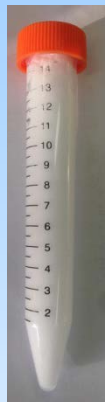
PSm



TBP



n-dodecane



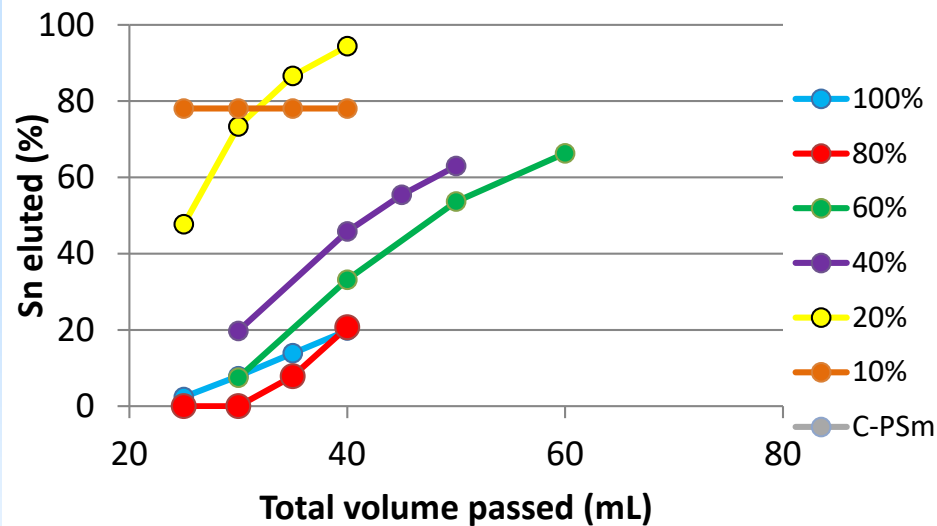
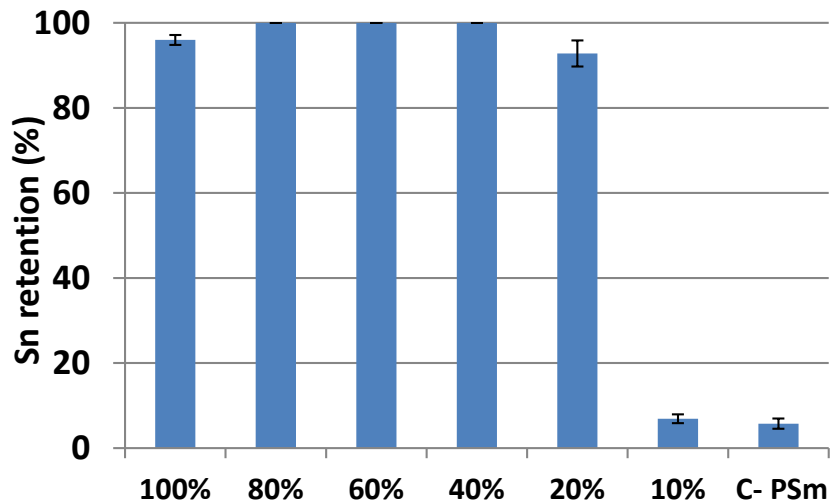
Agitate 24 h
Filtrate
Rinse with H₂O

Results and discussion

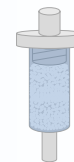
Proportion



0-100% TBP

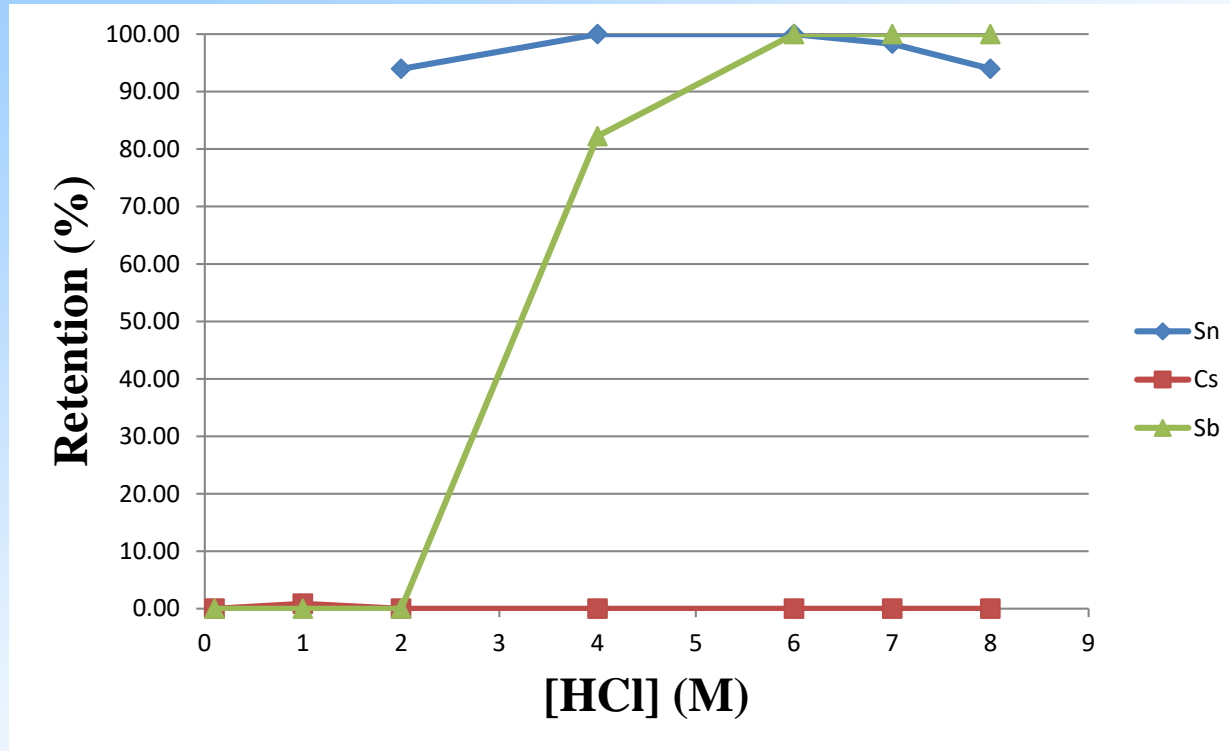


Best PS resin proportion
80% TBP



Results and discussion

Batch medium determination



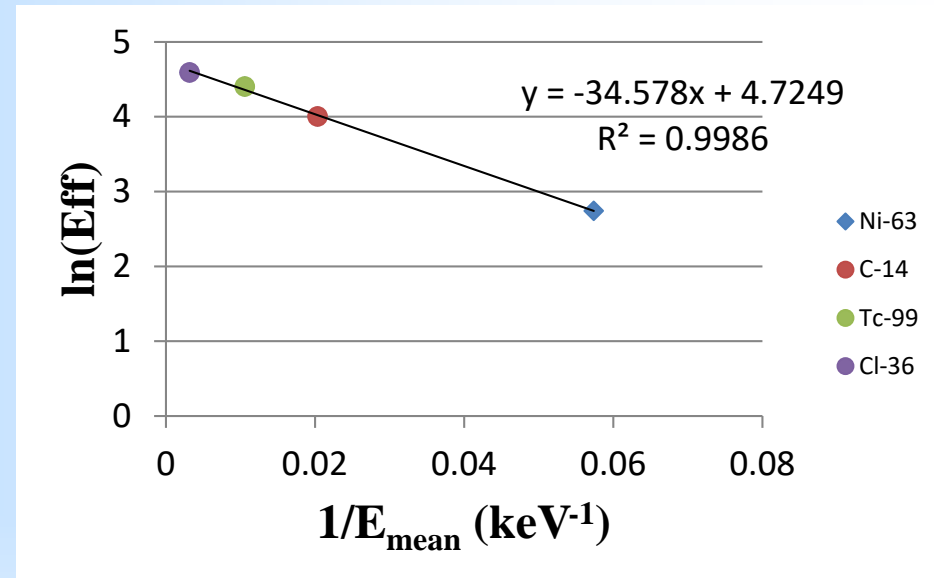
Optimum medium
HCl 2 M

Results and discussion

Calibration

Isotope	Mean Energy (keV)	Detection efficiency (%)
^{63}Ni	17.43	15.5
^{14}C	49.16	54.8
^{99}Tc	94.60	81.7
^{36}Cl	316.00	98.5

Isotope	Mean Energy (keV)	Detection efficiency (%)
^{126}Sn	118.7	83.7
$^{121\text{m}}\text{Sn}$	120.7	

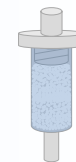


$$\text{Eff} = 112.68 \cdot e^{-\frac{34.56}{E_{\text{mean}}}}$$

Results and discussion

Quantification

Isotopes	Estimated Activity (dpm/g)
^{126}Sn	79
$^{121\text{m}}\text{Sn}$	4988
^{241}Am	56
Total activity	5067



Laboratoire Nationale Henry Becquerel

Replicate	Count rate (cpm)	Activity (dpm/g)	Quantification Error (%)
R1	420.00	5004	1.3
R2	420.09	4943	2.5
R3	412.46	4851	4.3
Mean		4933 ± 77	

Quantitative retention

Results and discussion

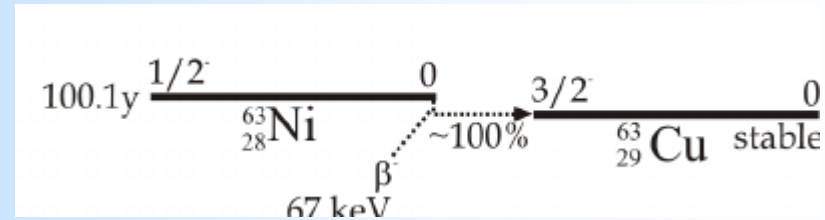
^{63}Ni

Preparation strategy

Immobilization

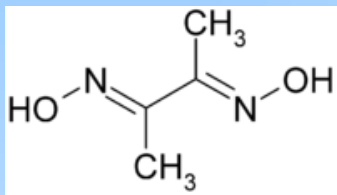
Imprinted

Covalent bound

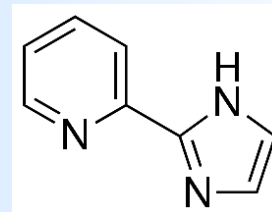


Results and discussion

Immobilization

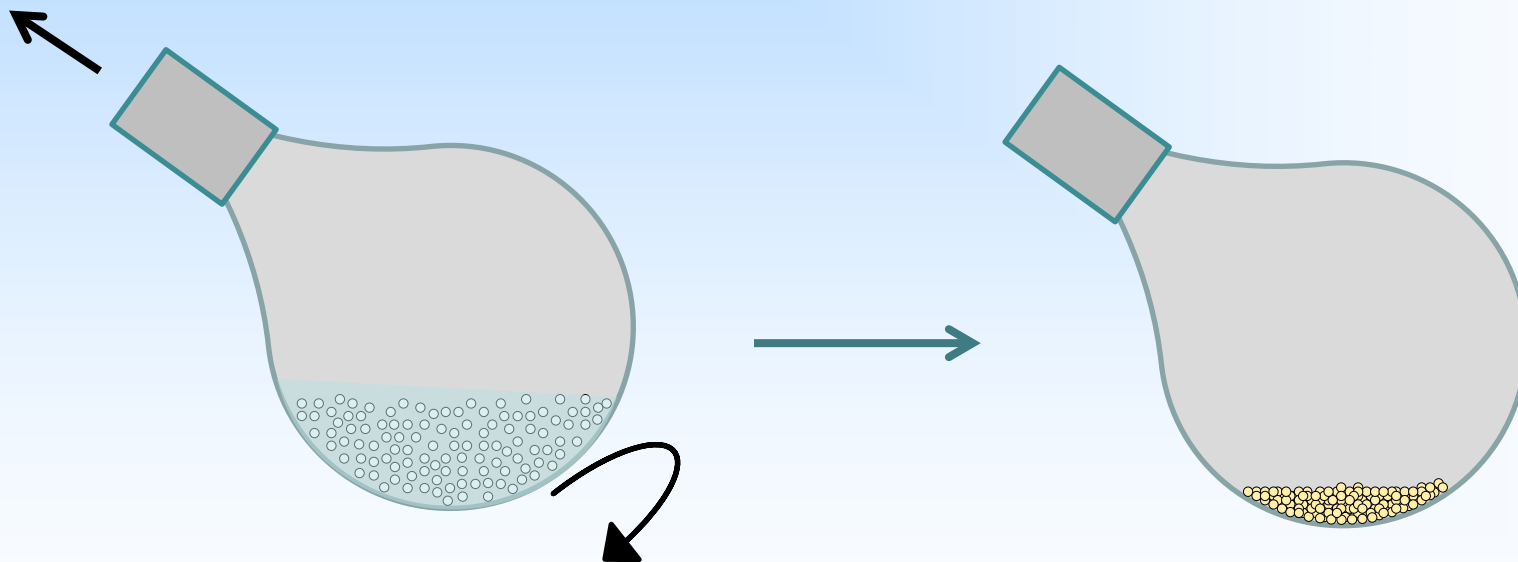


DMG



(2-1H-imidazol-2-il)piridina

With/without 1-octanol

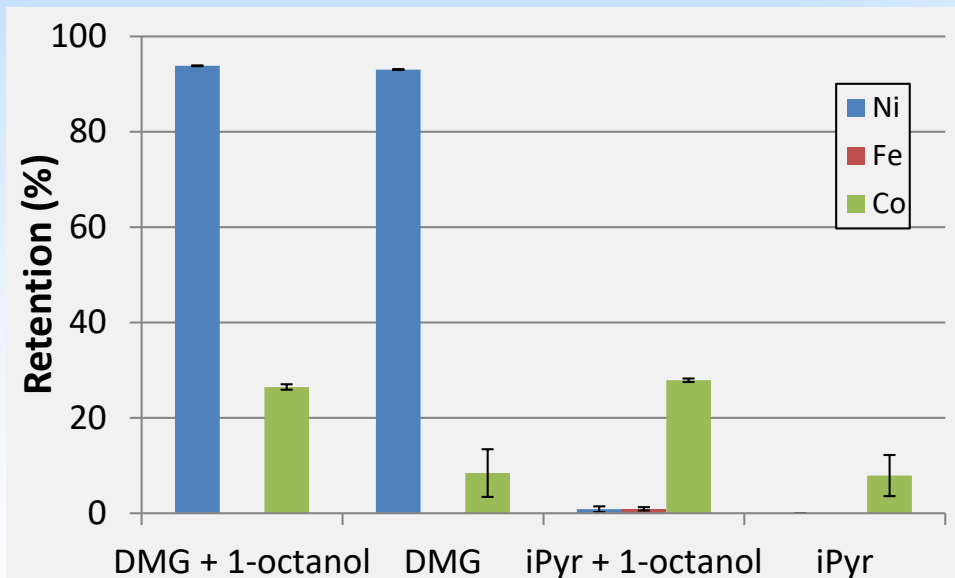


Results and discussion

Resins properties

Medium:
Ammonium
citrate pH 8

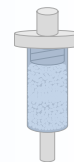
Resin	Detection efficiency(%)	
	Solution	Evaporated
DMG + 1-octanol	11.0±1.1	29.4±1.5
DMG	14.6±1.3	17.9±0.4
iPyr + 1-octanol	8.1±1.0	12.4±1.1
iPyr	7.9±0.6	27.6±1.5



Best column:
DMG

Results and discussion

Column analysis



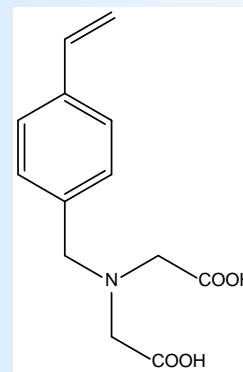
Total Efficiency = Detection Efficiency x Retention yield

Resin	Total Efficiency (%)
DMG + 1-octanol	0.15 ± 0.04
DMG	0.54 ± 0.07

Lost of the extractant

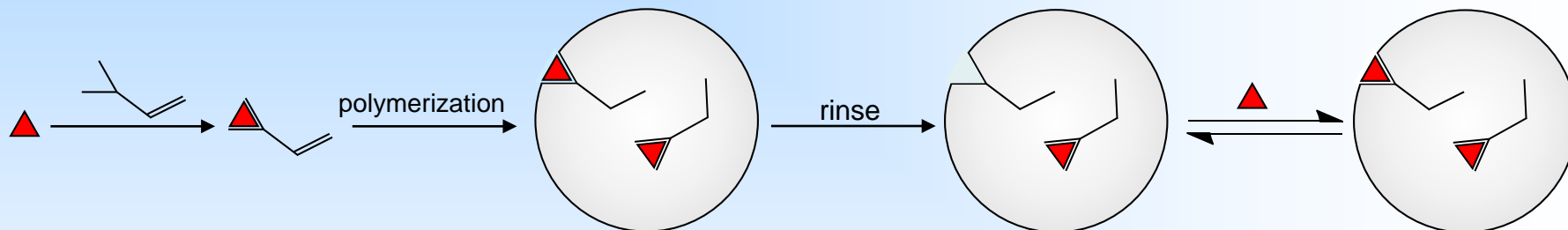
Results and discussion

Imprinted



VbIDA

Synthesis in presence of template



Selectivity based on steric impediment

No break through volume

Use of generic extractants

Results and discussion

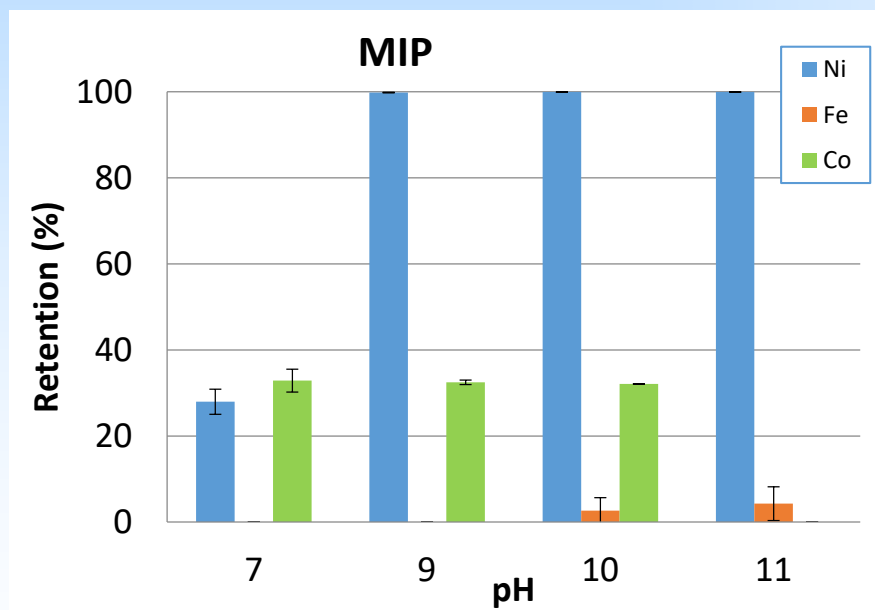
Retention

Medium:
Ammonium
citrate pH 7-11

Resin	Detection efficiency(%)		SQP(E)	
	Solution	Evaporated	Solution	Evaporated
MIP	3.1±0.4	11.8±0.9	506.1	475.4



Optical
quenching

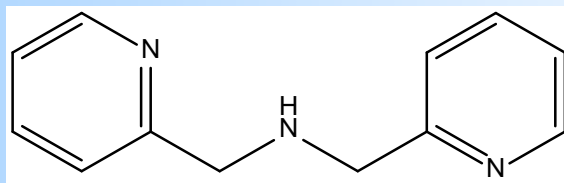


Preliminary results

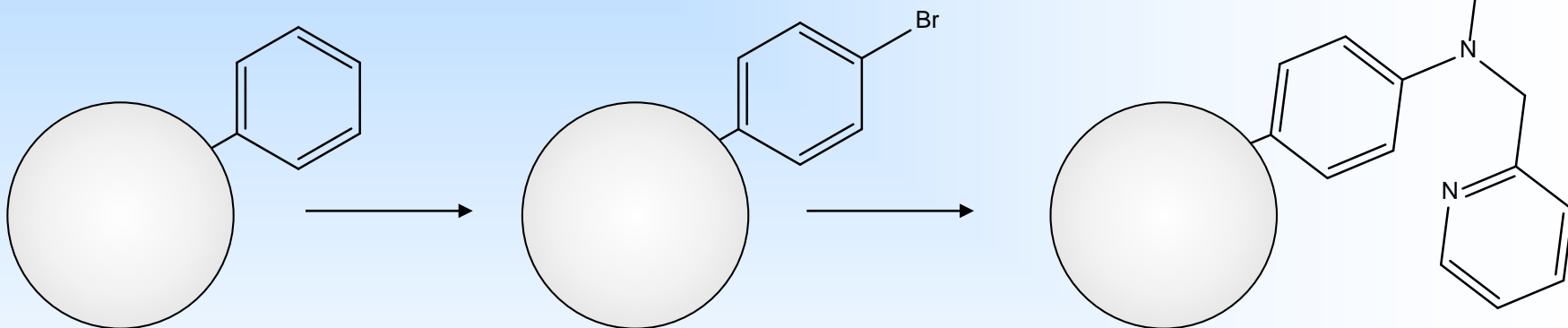
High selectivity

Results and discussion

Covalent bound



Di-(2-picoyl)amine

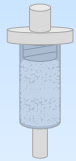


No break through volume
More reproducible

Conclusions



A new PS resin for ^{126}Sn determination has been developed



Different approaches for the preparation of a ^{63}Ni PS resin were evaluated

MIP procedure shows a high selectivity

Acknowledgments

- Ministerio de Economía y Competitividad (MINECO) for financial support under CTM2014-02020
- Agència de Gestió d'Ajuts Uiversitaris i de Recerca (AGAUR) for financial support under 2014-SGR-1277.
- Dr. Philippe Cassette from LNHB (France) for supplying the ^{126}Sn solution.

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