

***New ion sources for surface analyses and modification:
Polyions***

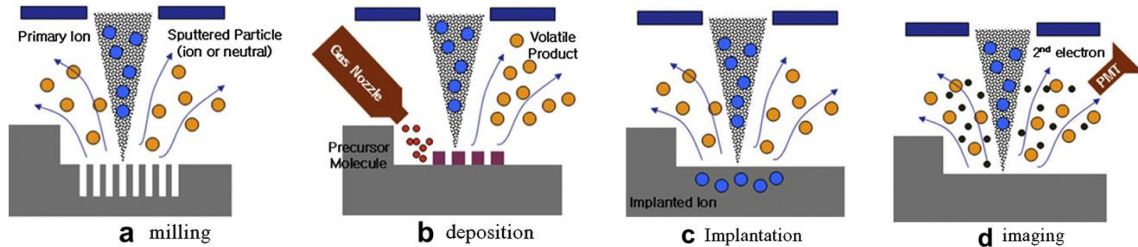
Thanh Huong Lai, Thanh Loan Lai, Isabelle Ribaud, François Daubisse,
Vincent Huc, Serge Della Negra

Polyions « in a nutshell »

1 – Polyions ? → a new ion technology for the production of ions in the gas (→ new ion source)

Microelectronics

- prototyping, (micro/nano-machining, materials deposition (nm)) : FIB technology (Focused Ion Beam) : nano(scissors/pencils)
- Ionic implantation



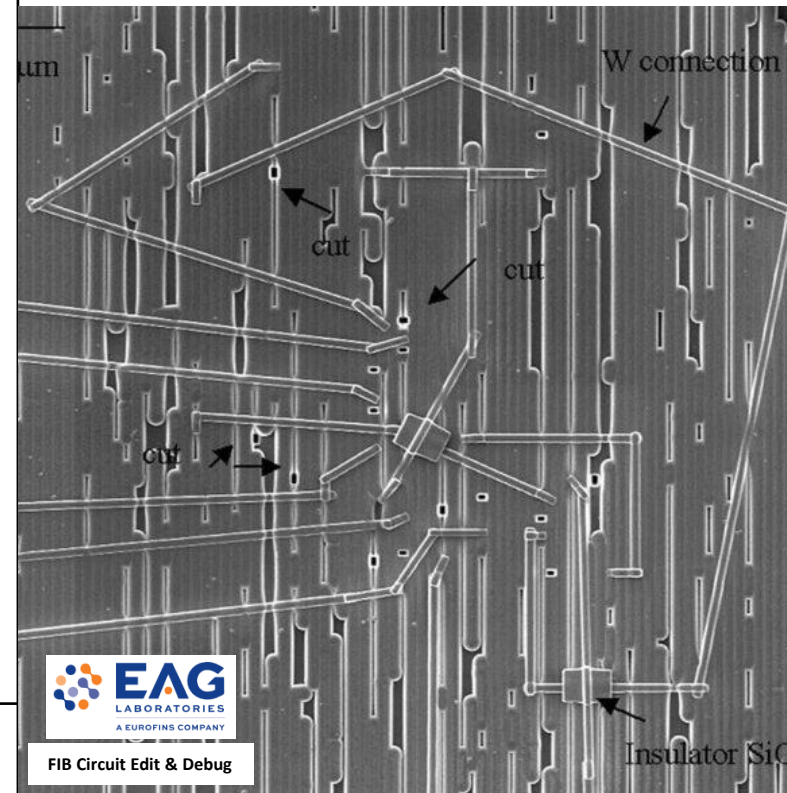
Surface Analysis, ionic imaging :

Materials, biology, health...

4 – What's our solution ?

To develop a new ions source:

- General purpose → very large panel of ions in the gas phase,
- Soft operating conditions,
- High brightness
- Long lifetime.



Components manufacturers:

Orsay Physics
FEI
ULVAC-PHI
adzu
of

Microelectronics Industrials :

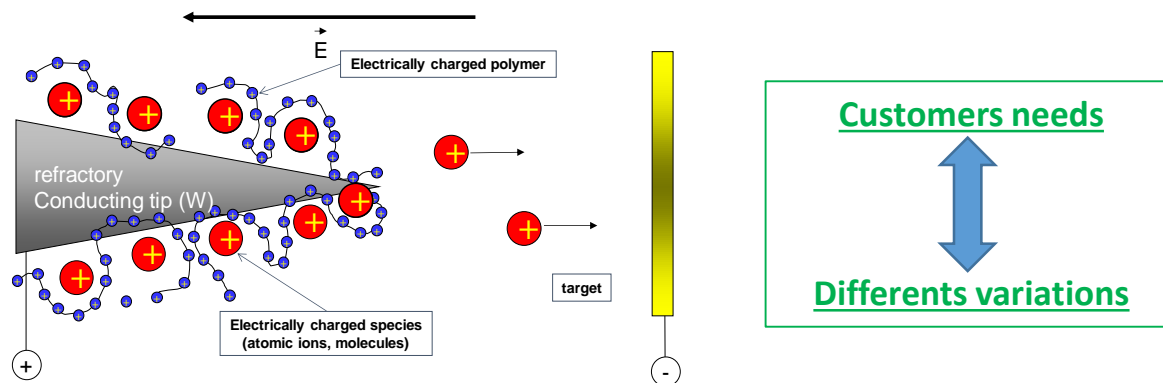
developments
sources buyers

It is currently difficult to obtain boranes for ionic particles

- A high delivered intensity in the area to be analysed/modified
- « dual » sources(+/-)
- Improved sensitivity for surface analysis: chemically reactive ions, heavy ions (nanoparticles)

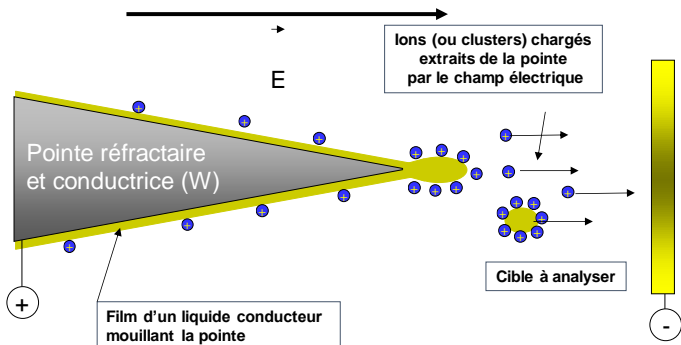
Polyions:

preforming the ions to be extracted
By chemical mans means



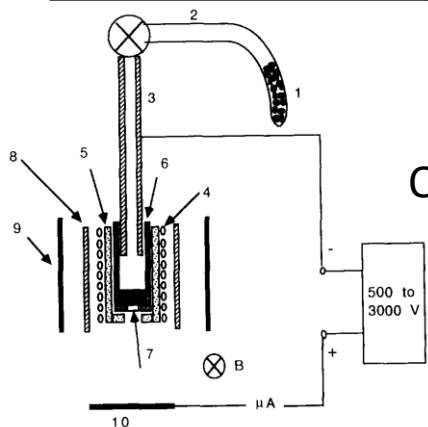
Concurrents & concurrent technologies

LMIS (Liquid Metal Ion Source)/ ILIS (Ionic Liquid Ion Source)



LMIS	ILIS
Metals/ Eutectics (Ga, AuSi AuGe...)	Ionic liquids Cations: [emim] ⁺ , [bmim] ⁺ Anions: [Tf2N] ⁻ , [BF4] ⁻
30-500°C	TA

Surface Ionisation (ex. Iodine)



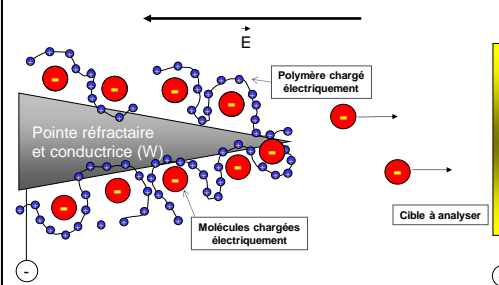
Oven (→ 1200°C) → vapors → extraction

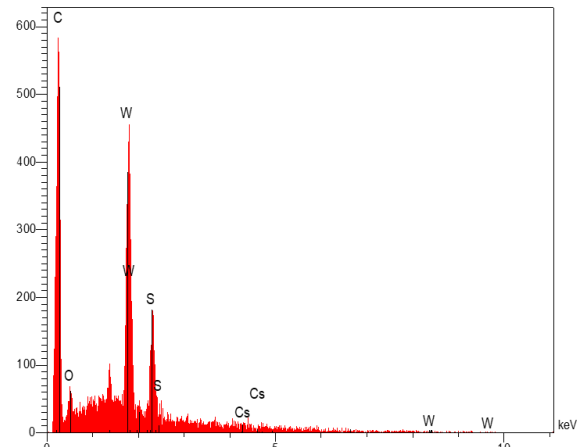
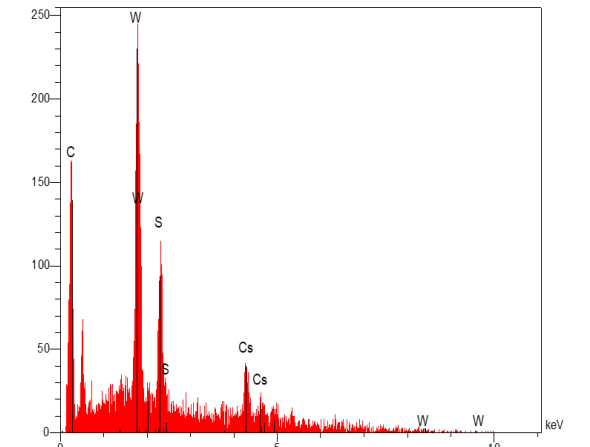
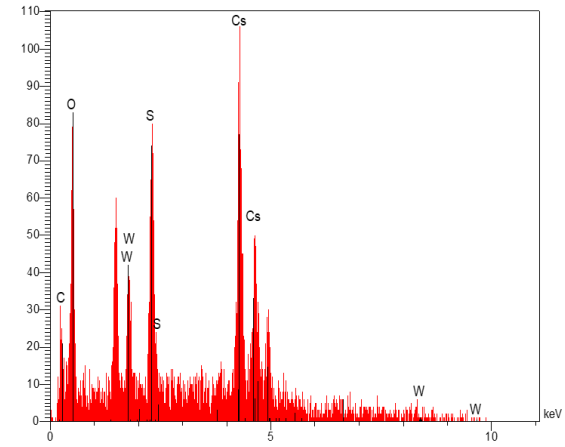
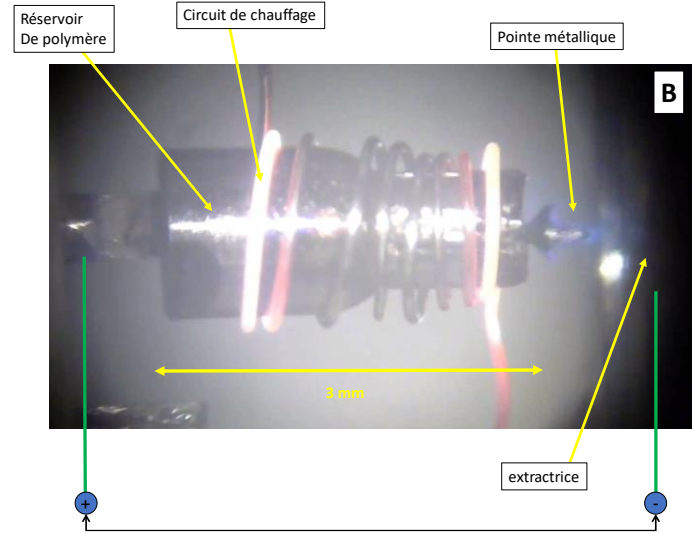
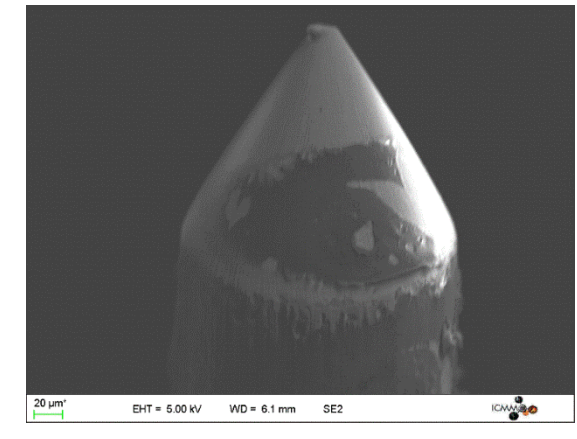
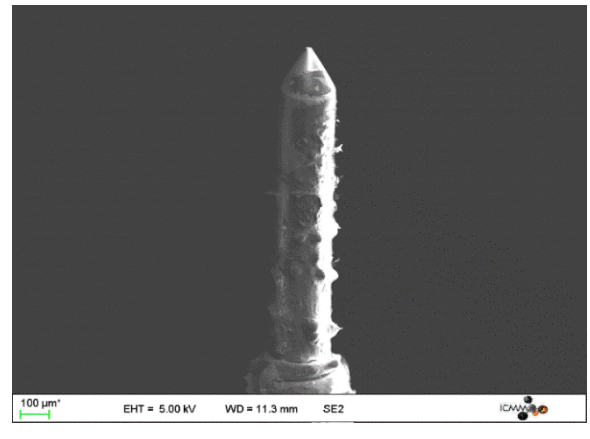
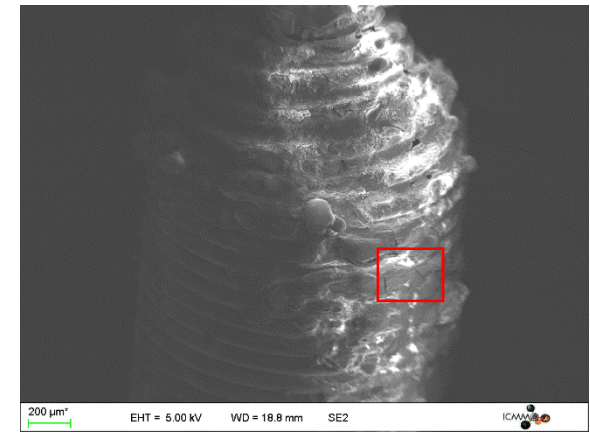
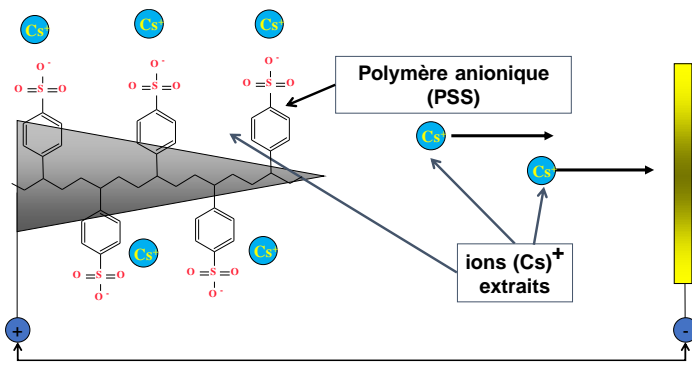
Comparison & advantages

	LMIS	Surface Ionisation	ILIS	POLYIONS
realisation	Green	Red	Green	Green
brightness	Green	Orange	Green	Green
User-friendly	Green	Red	Green	Green
Ions choice	Red	Red	Yellow	Green
lifetime	Green	Yellow	Yellow	Yellow
Ionic purity	Green	Green	Red	Yellow

LEIS: using polymers as matrices:

- Preparation of the ions to be extracted by chemical means → selectivity, easier extraction
- Large choice of polymers/ions combinations
- Low T → broadened choice
- Reducing charged droplets extraction
- Different variations, as a function of customer's needs





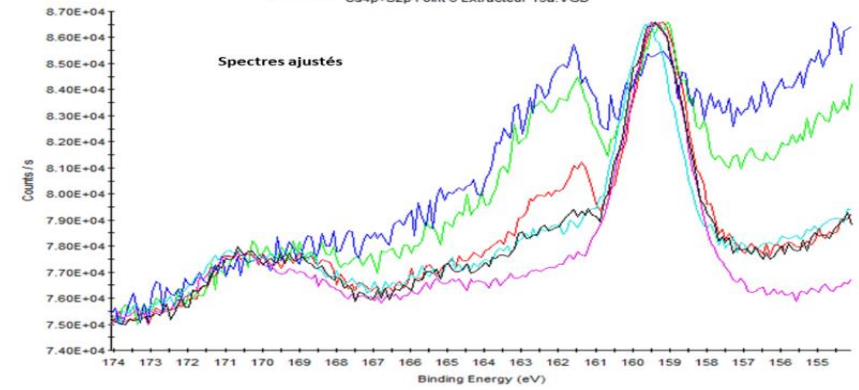
Compare-4
 — Cs4p-S2p Point 1 Extracteur 13a.VGD
 — Cs4p-S2p Point 2 Extracteur 13a.VGD
 — Cs4p-S2p Point 3 Extracteur 13a.VGD
 — Cs4p-S2p Point 4 Extracteur 13a.VGD
 — Cs4p-S2p Point 5 Extracteur 13a.VGD
 — Cs4p-S2p Point 6 Extracteur 13a.VGD

MEB-EDS source tip analysis:

The ionic polymer (PSS) is increasingly Cs-depleted from the bottom to the emitting tip.



Extracted Cs⁺ ions.



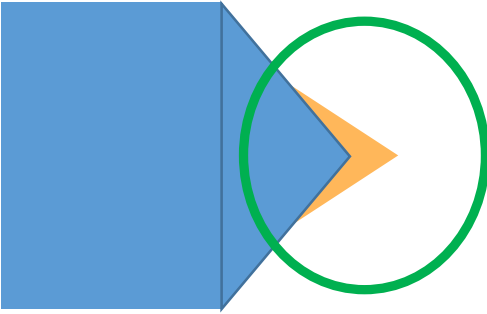
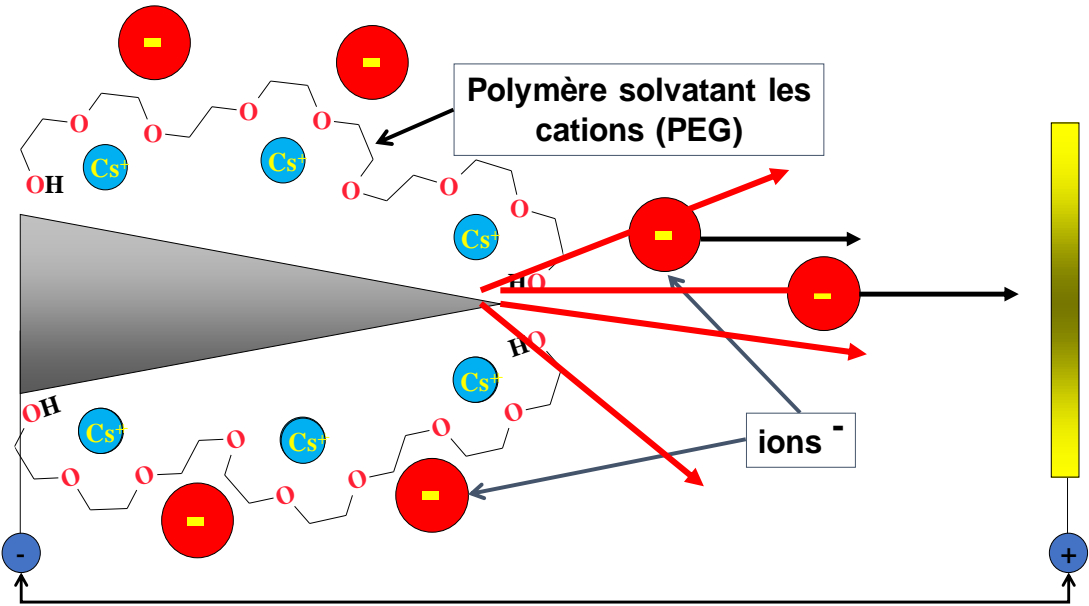
XPS target analysis:

Strongly Cs-enriched surface

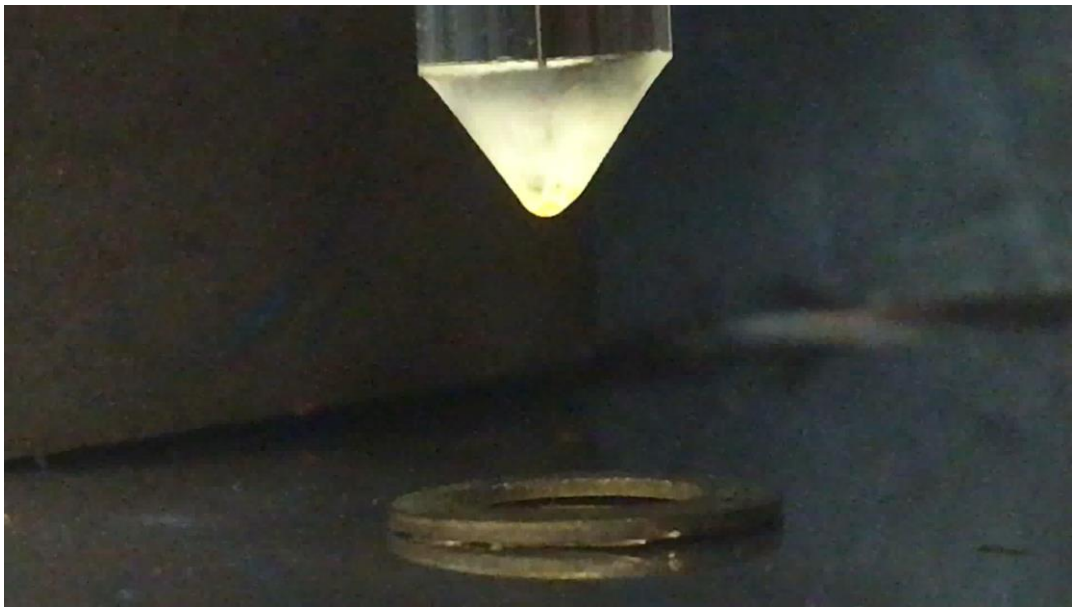
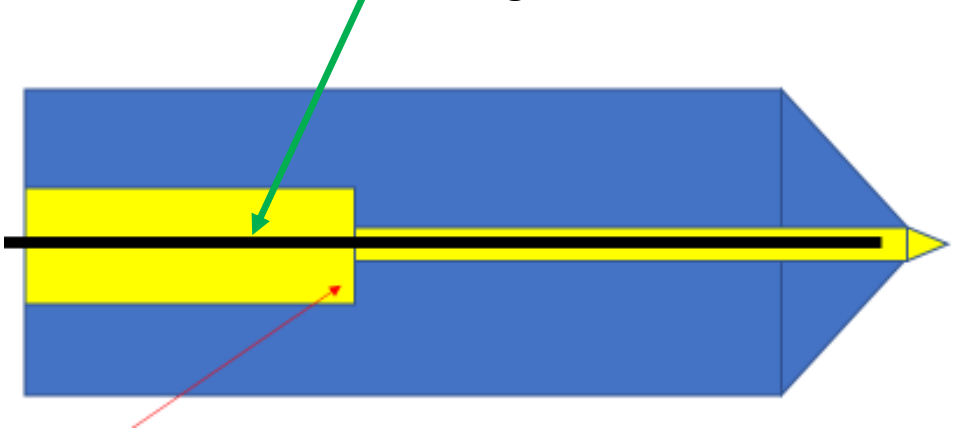


Extracted Cs⁺ ions.

extracting negative ions: new source designs needed



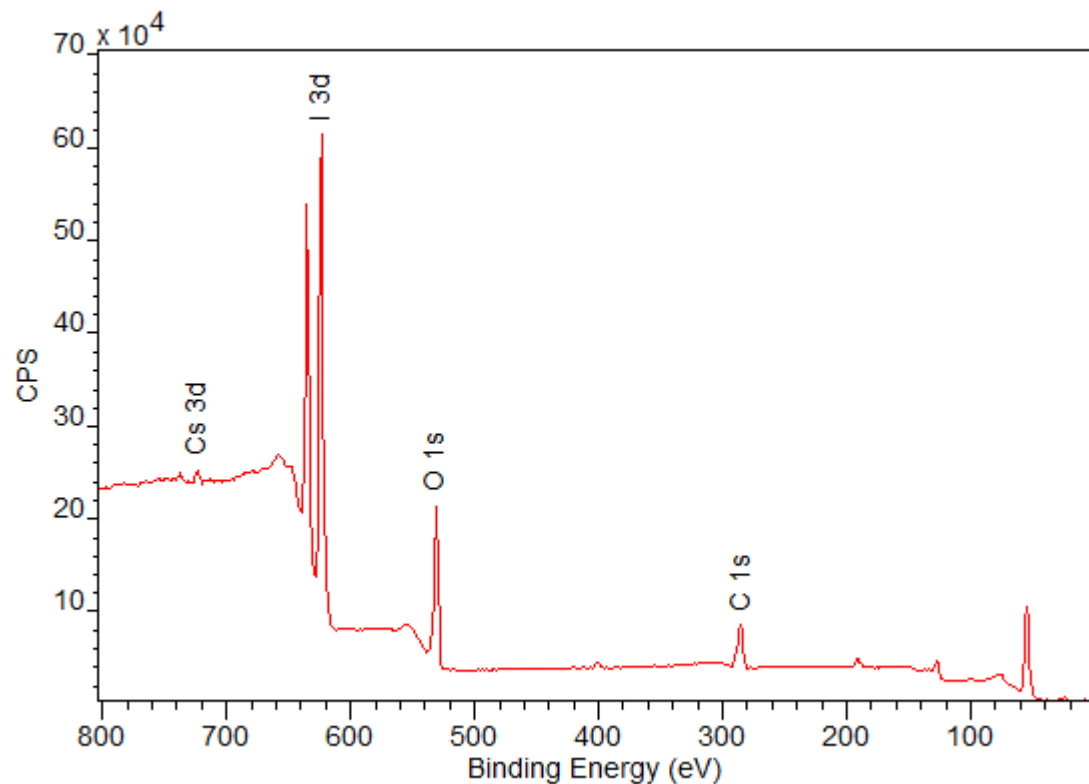
Mobile metallic wire → longer distance → no electrons



Under ambient conditions:
→ I⁻ ions emission demonstrated (facing target analysis)
→ Ambient temperature

Target XPS analysis

T 127- cal : survey/68

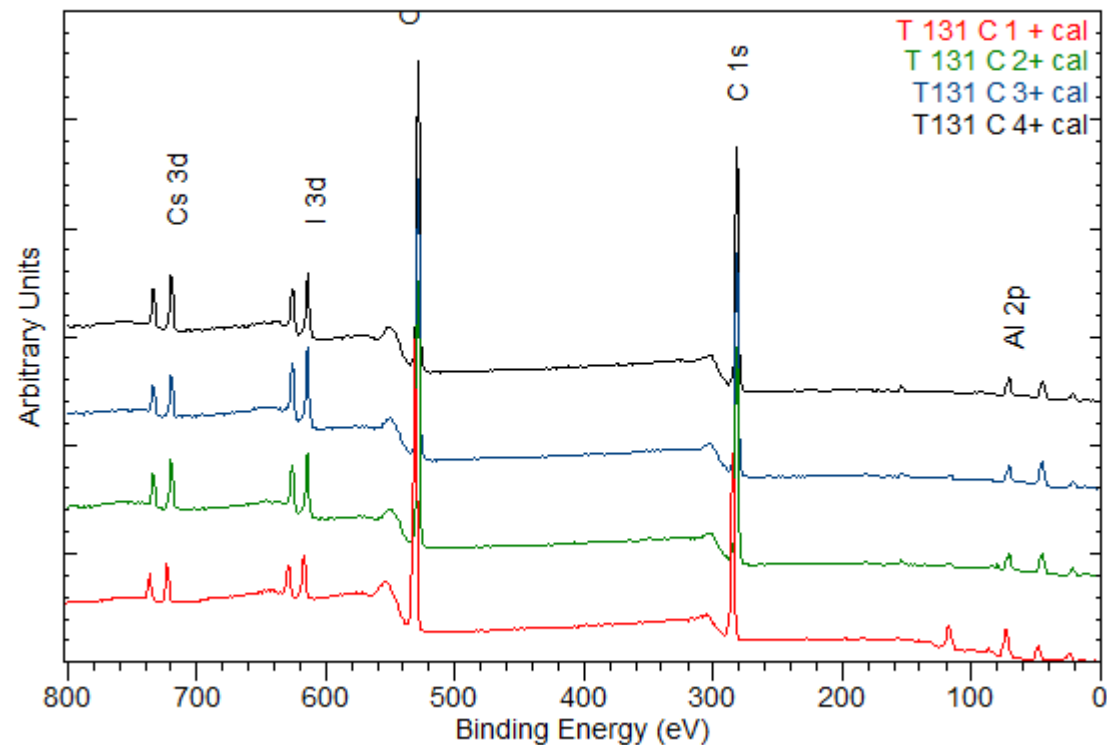


CasaXPS (This string can be edited in CasaXPS.DEF/PrintFootNote.txt)

T 127-	%At Conc
Cs 3d5/2	1.94
I 3d5/2	98.06

selective I- extraction!

survey/2



CasaXPS (This string can be edited in CasaXPS.DEF/PrintFootNote.txt)

T 131 C 1 +	%At Conc
Cs 3d5/2	43.29
I 3d5/2	56.71

T 131 C 2-	%At Conc
Cs 3d5/2	37.47
I 3d5/2	62.53

No selective I- extraction !

UHV conditions: Taylor cone → ions extraction...

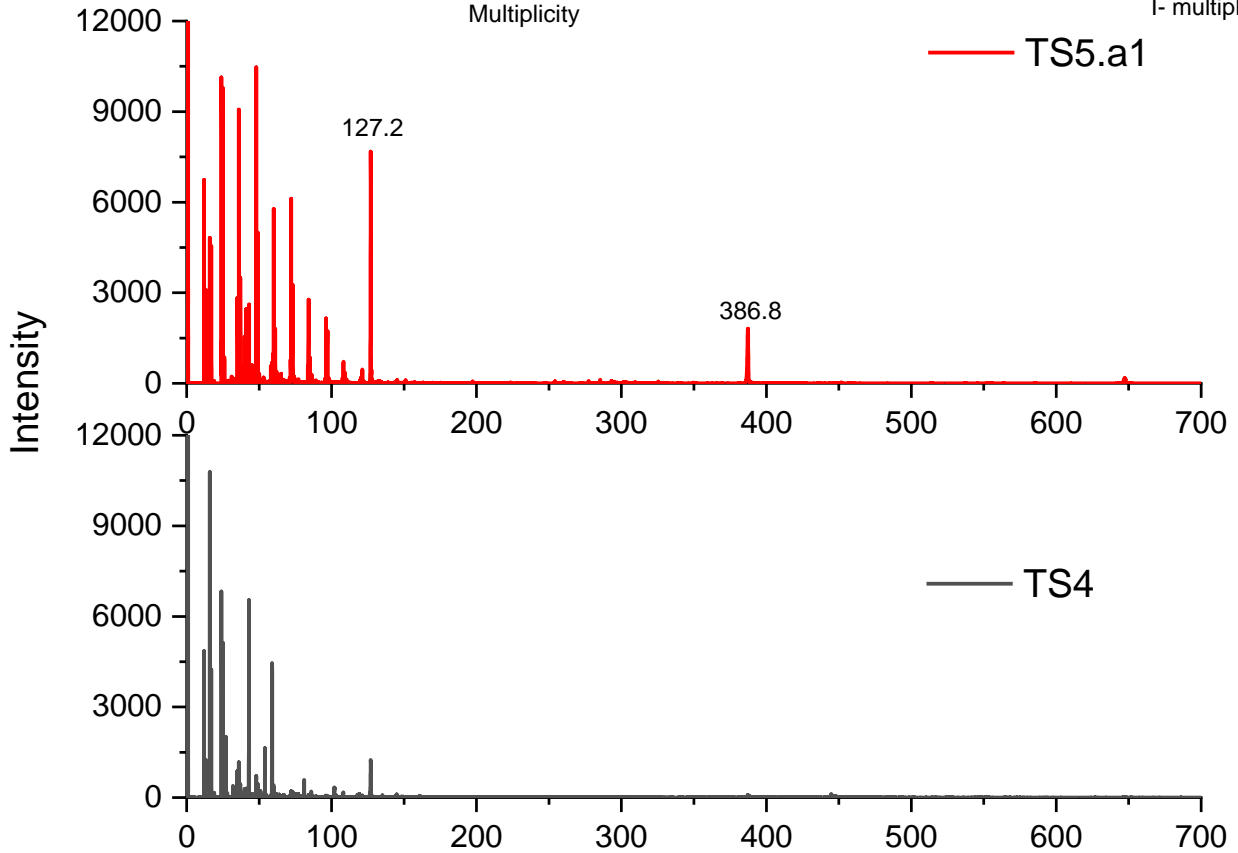
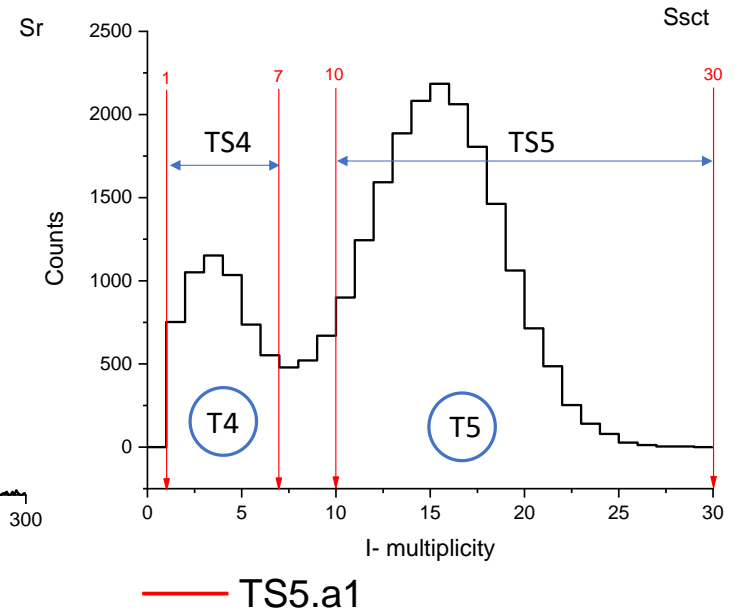
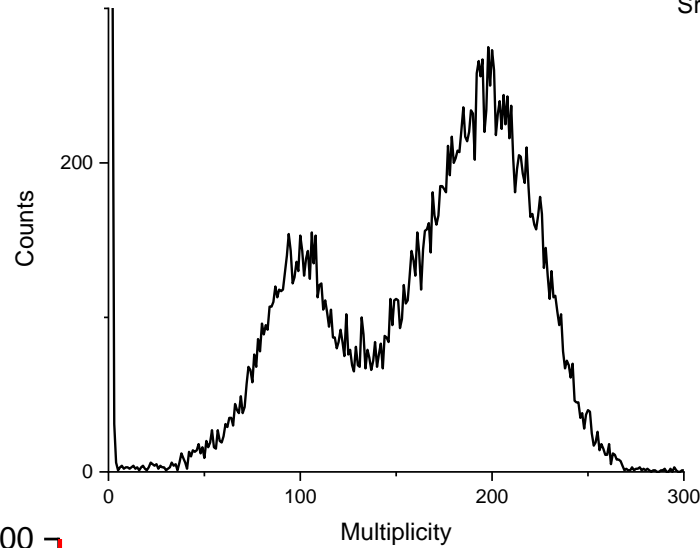
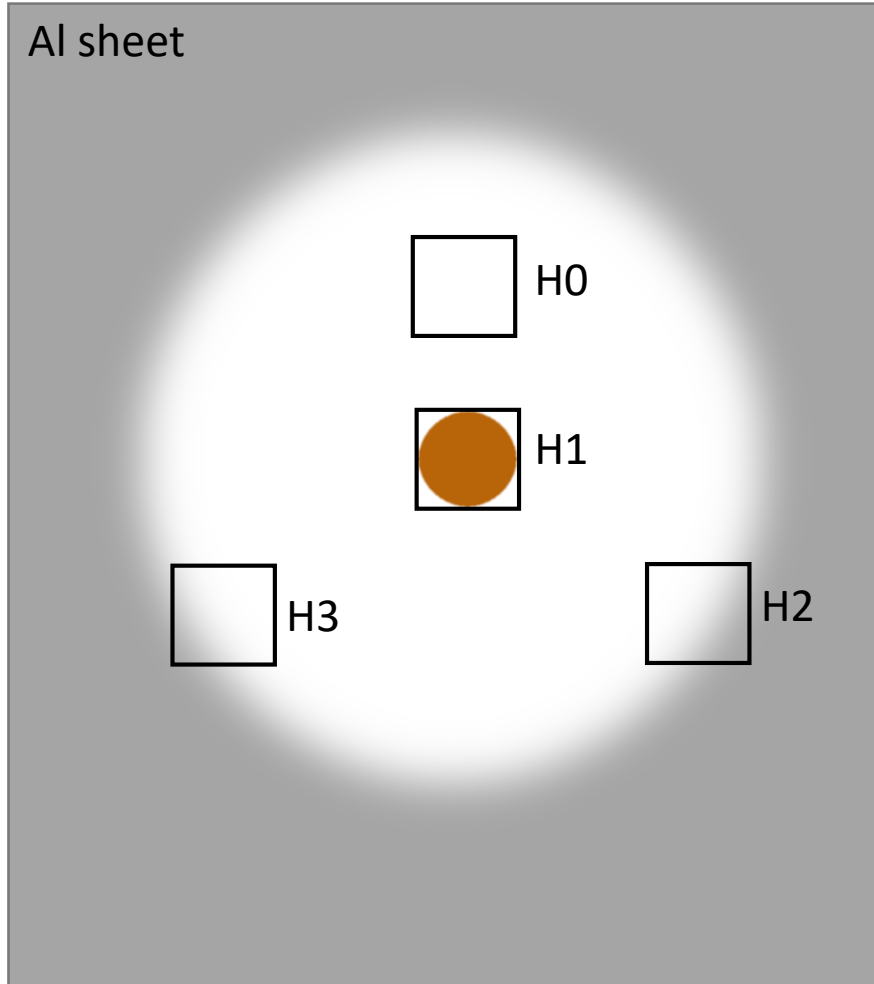
CsI 30% **XX** 10%



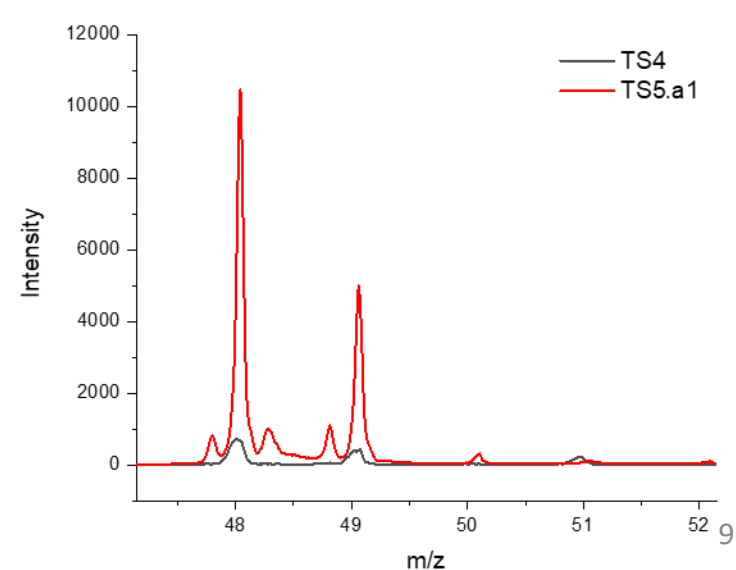
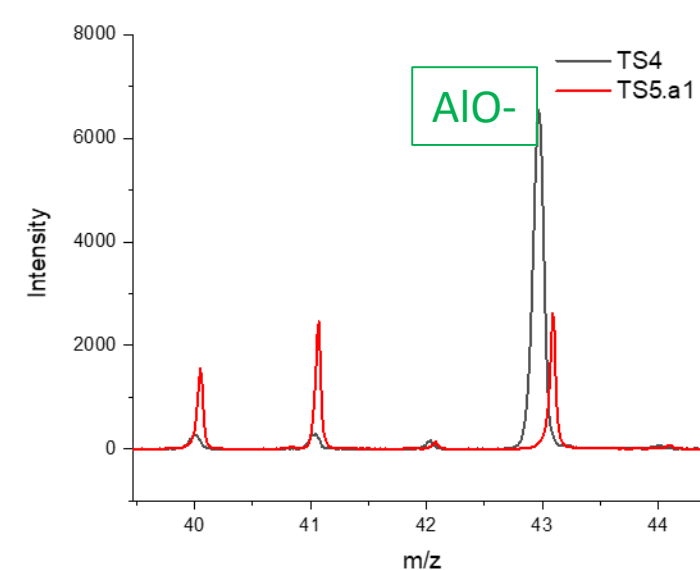
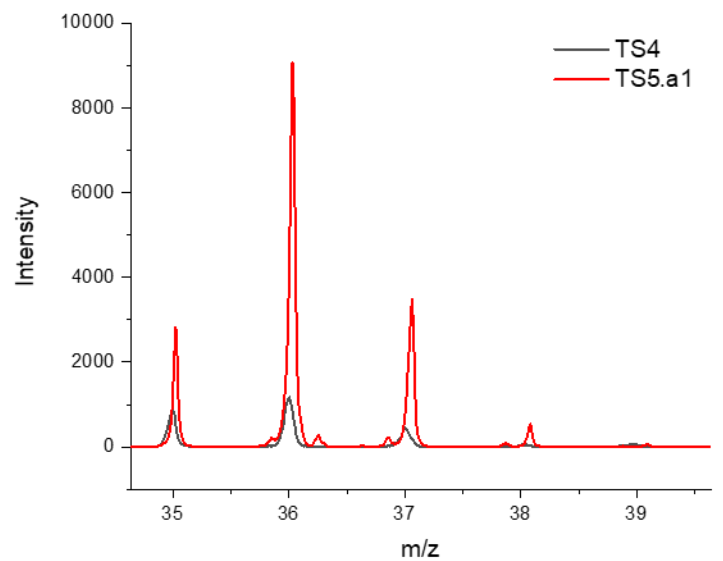
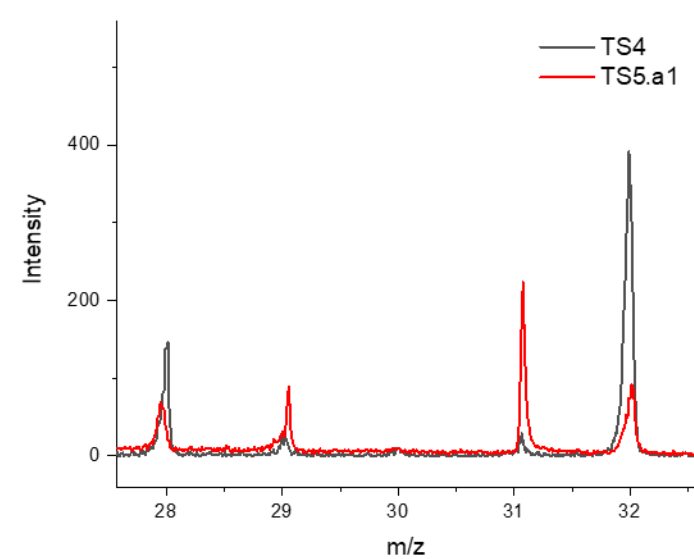
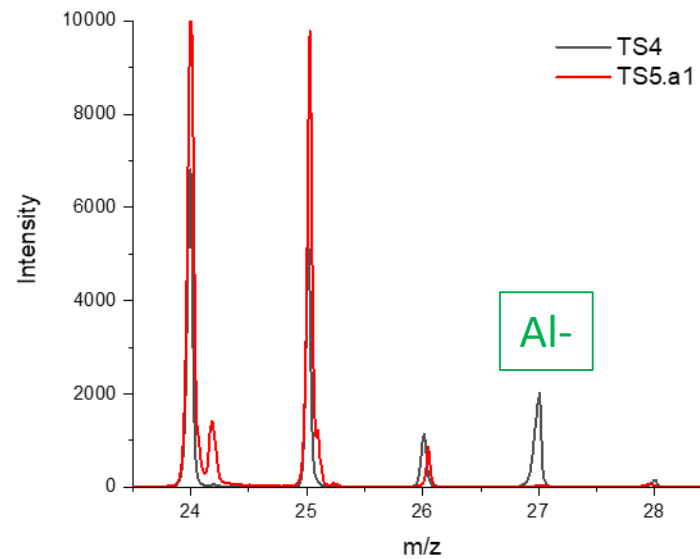
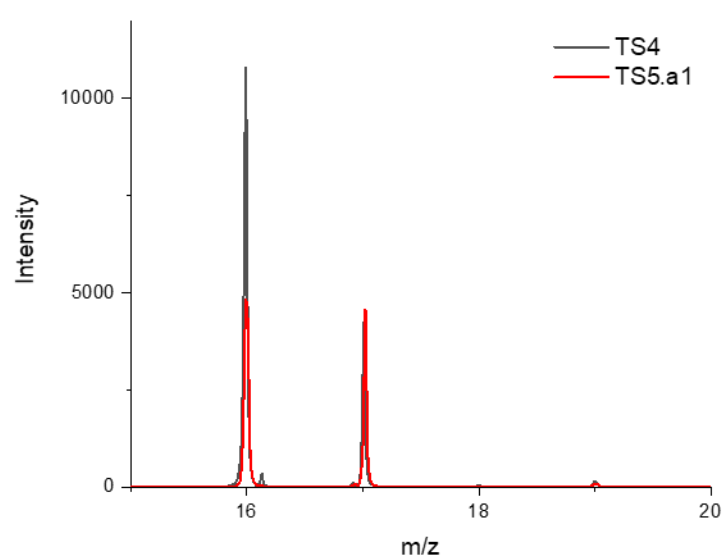
- Stable Taylor cone
- - spraying
- - perfectly dried compositions (degassing/ H₂O evaporation).

Formulations optimisation → improving ions mobility

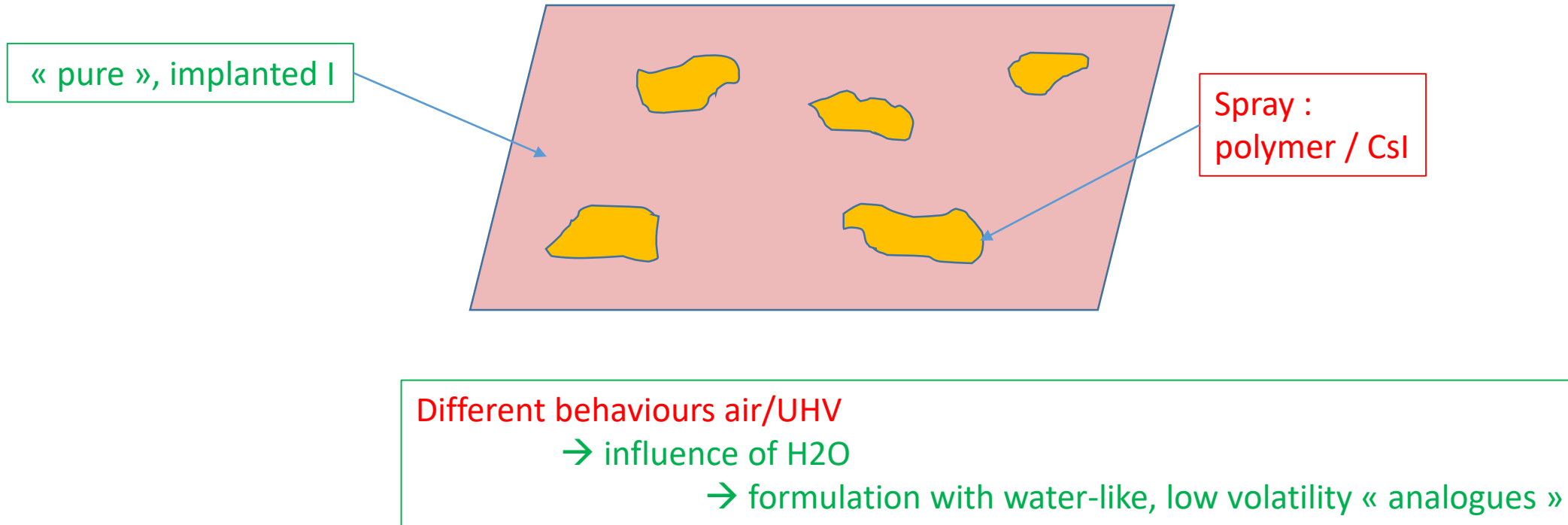
Getting a better understanding of spraying effects: ANDROMEDE



Getting a better understanding of spraying effects: ANDROMEDE



Getting a better understanding of spraying effects: ANDROMEDE



Conclusions:

- Efficient new sources designs
- New efficient polymers / ions formulations tested
- specific ion extraction demonstrated under very soft conditions (close to ambient temperature (atmospheric / UHV)
- Good ionic purity, to be improved under UHV

Special thanks to:



You for your kind attention