

————— *Journée sur la fonctionnalisation en microscopie champ proche – Toulouse, 29 Nov* —————
2023

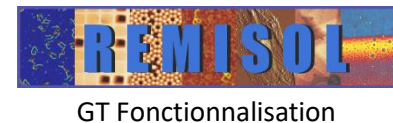
Probe functionalization:

Use of functionalized tip to probe the biomolecule-inorganic surface interface

Joanne Lê-Chesnais, PhD student

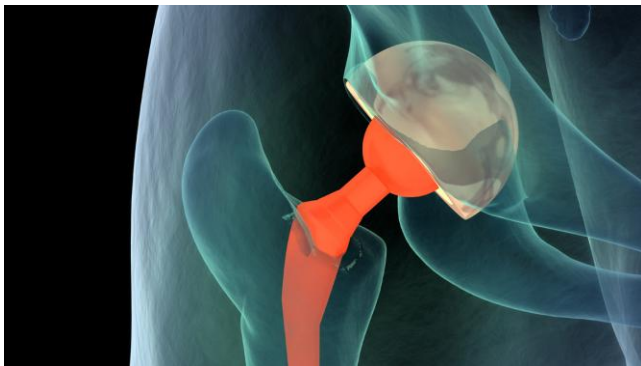
Dr. Jessem Landoulsi, Pr. Jean-François
Lambert

Laboratoire de Réactivité de Surface, UMR 7197

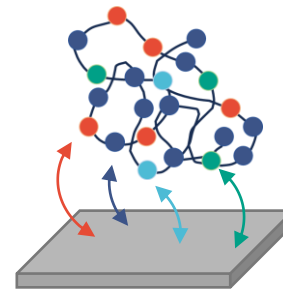




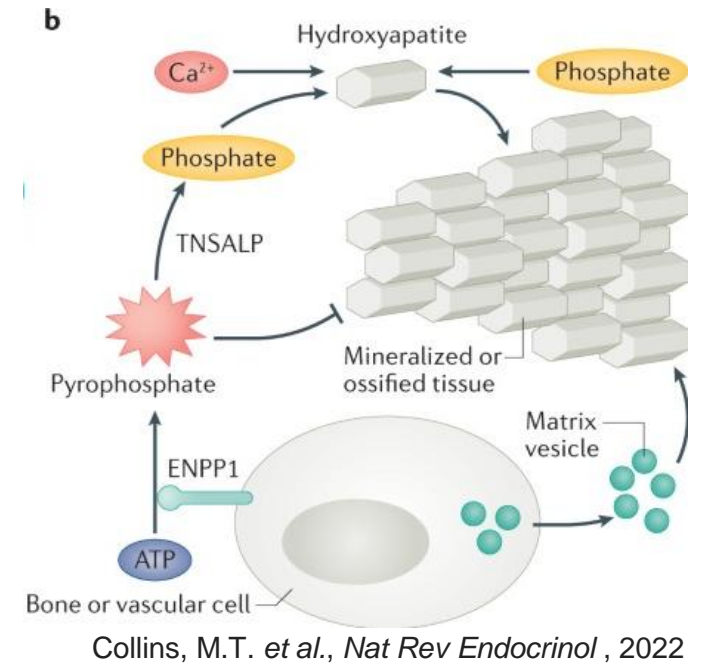
Origins of life



Biomedical devices

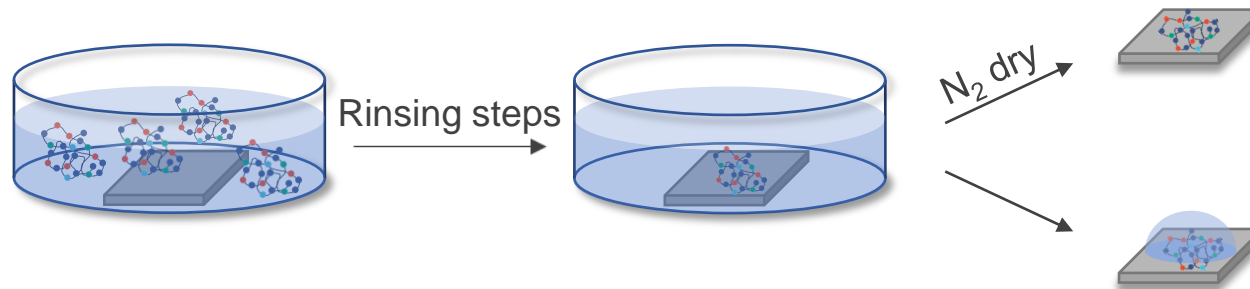


Electrostatic interactions
Hydrophobic interactions
Van der Waals attraction
Covalent bonding

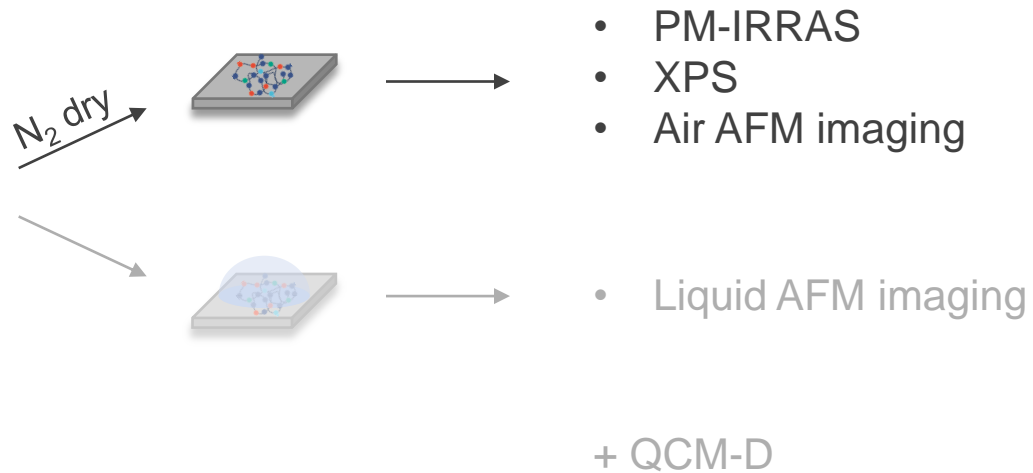


Biomineralization

- **Classical methods used to study the biomolecule-inorganic surface interface**

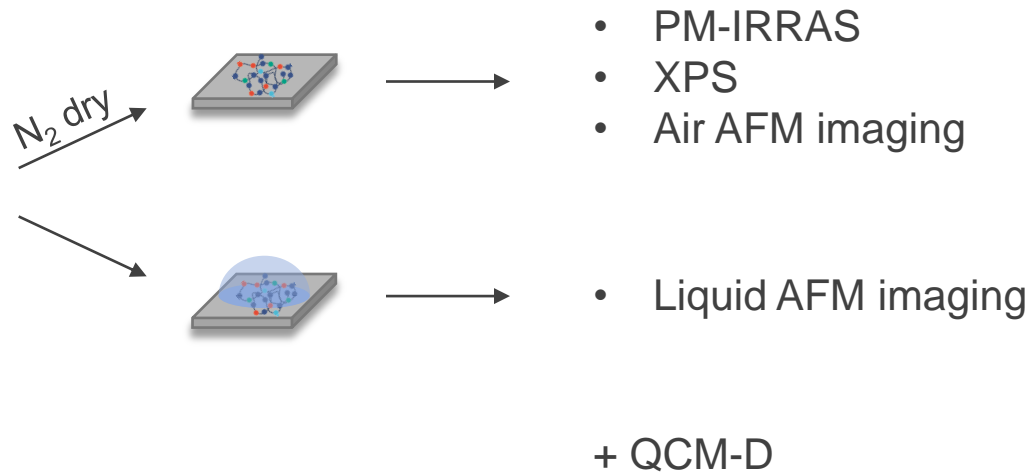


- **Classical methods used to study the biomolecule-inorganic surface interface**



Change of conformation following the drying step

• **Classical methods used to study the biomolecule-inorganic surface interface**



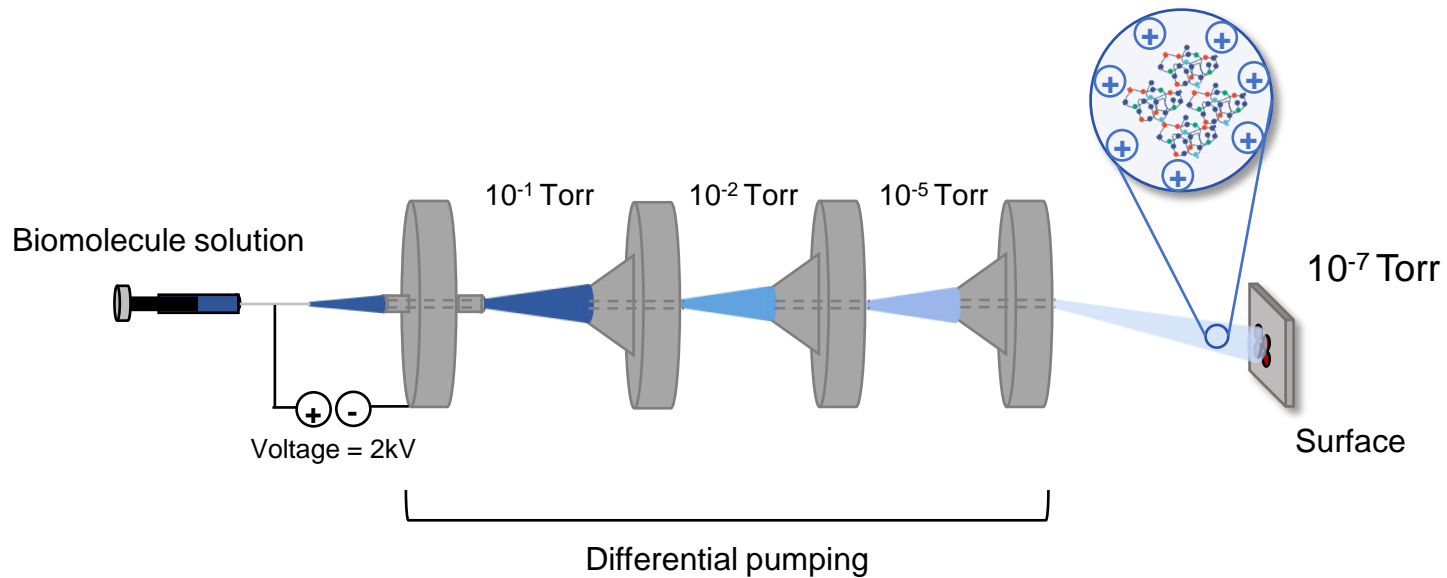
Change of conformation following the drying step

Omnipresence of adventitious organic contaminants

➤ **limit the selectivity of the characterization of adsorbed molecules of interest**

Molecule-molecule interaction VS molecule-surface interaction

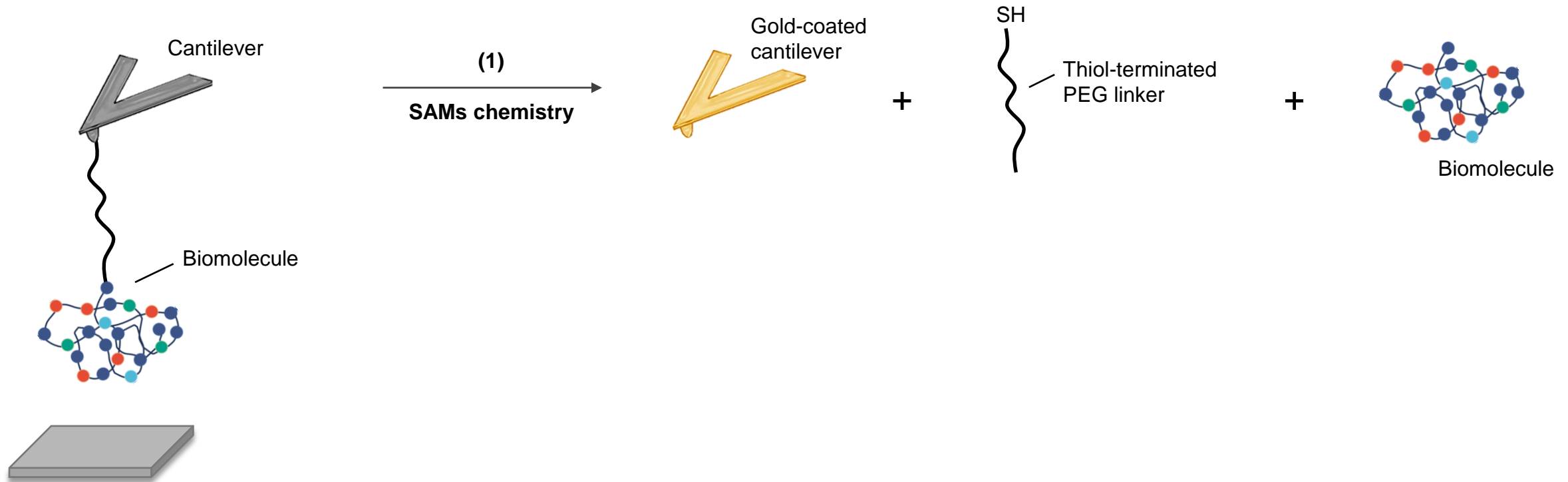
- Electrospray – Ion beam deposition (ES-IBD)**



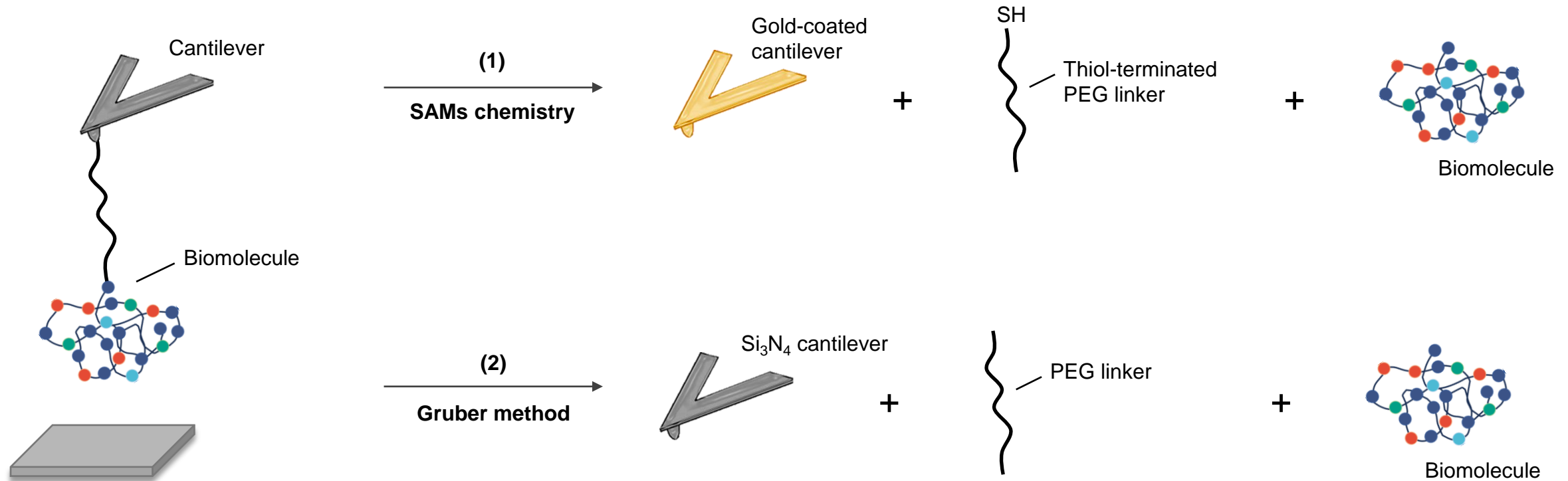
Molecular soft-landing of biomolecules on solid surfaces

- Preservation of molecular structures
- Drastic reduction of adventitious organic contaminants

- Force spectroscopy : tip functionalization

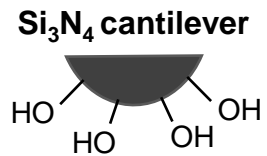


- Force spectroscopy : tip functionalization

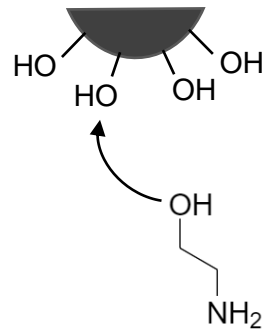


- Force spectroscopy : tip functionalization
Gruber method

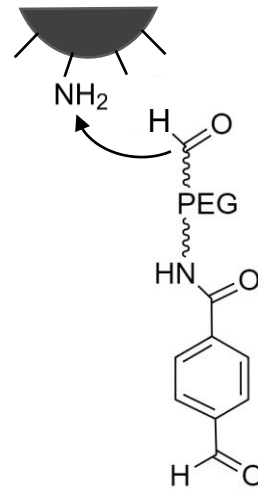
1/ Tip cleaning



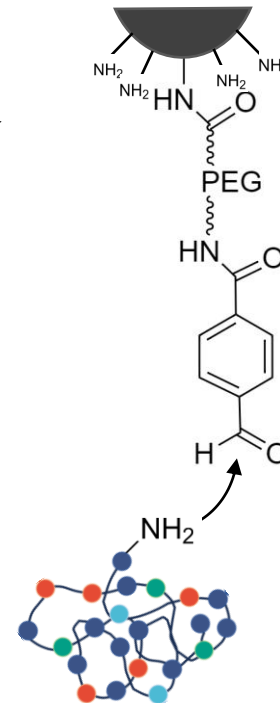
2/ Amine-functionalization



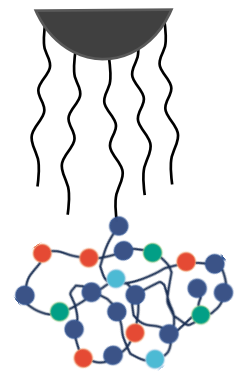
3/ Linker-functionalization



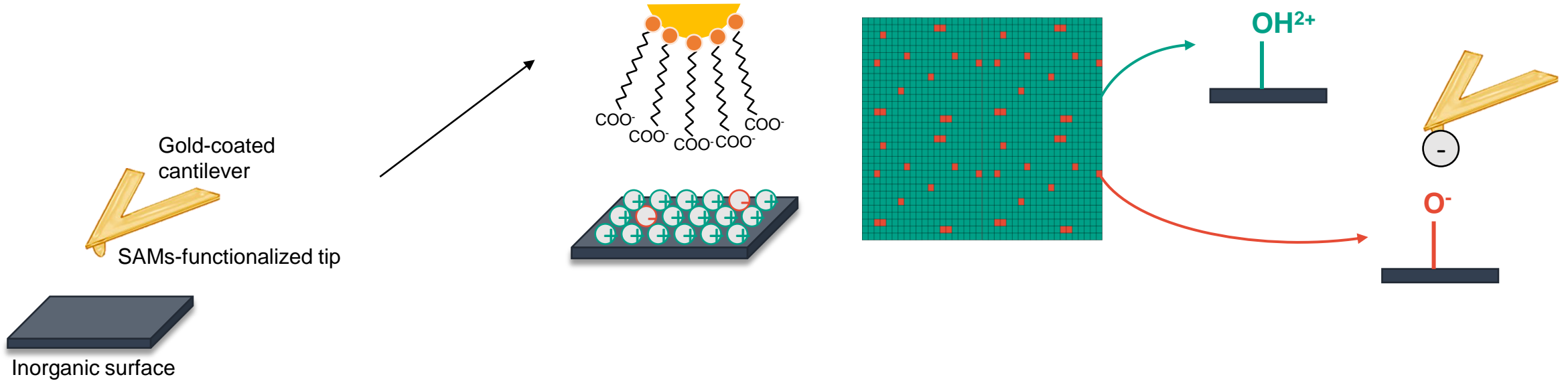
4/ Linking of the biomolecule



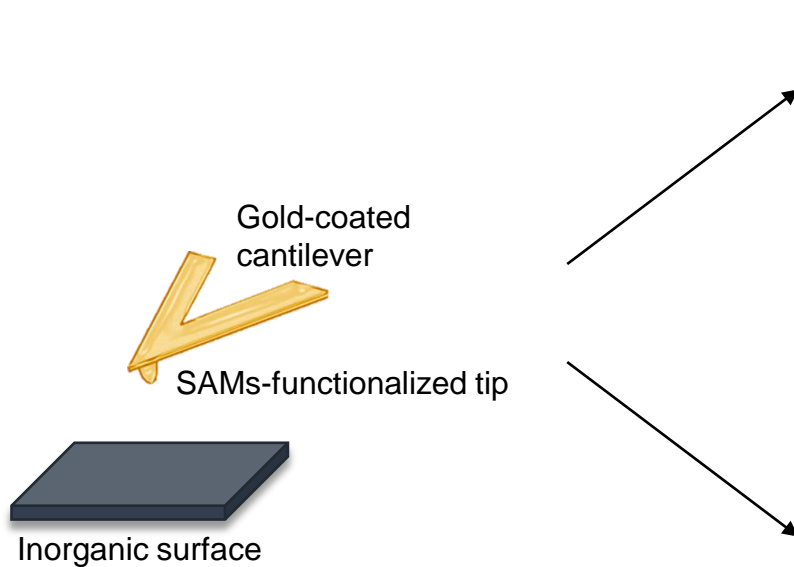
5/ Biomolecule-functionalized tip



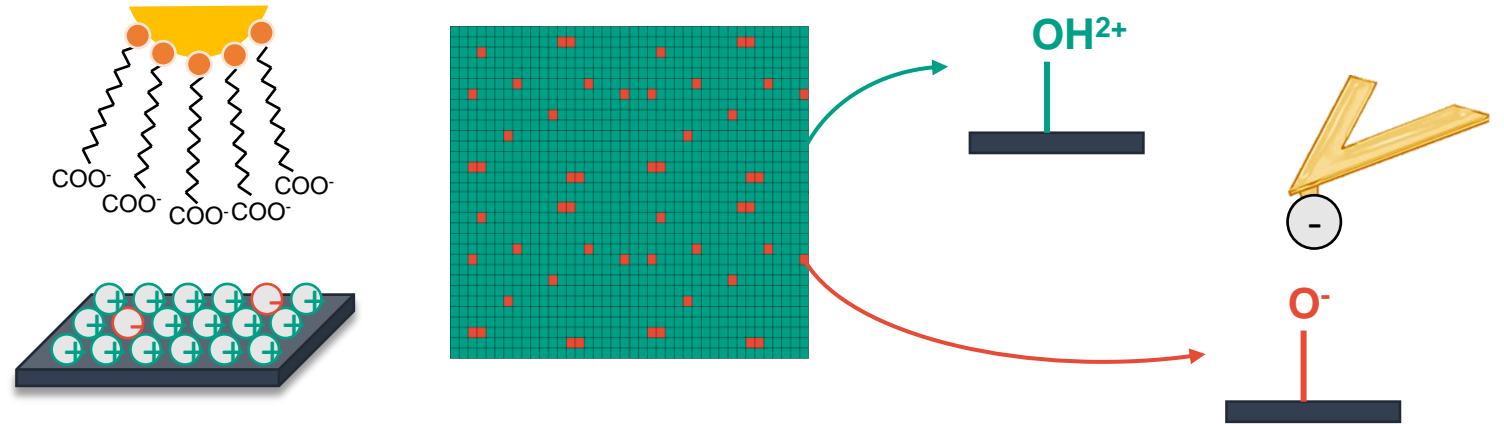
- Type of interactions



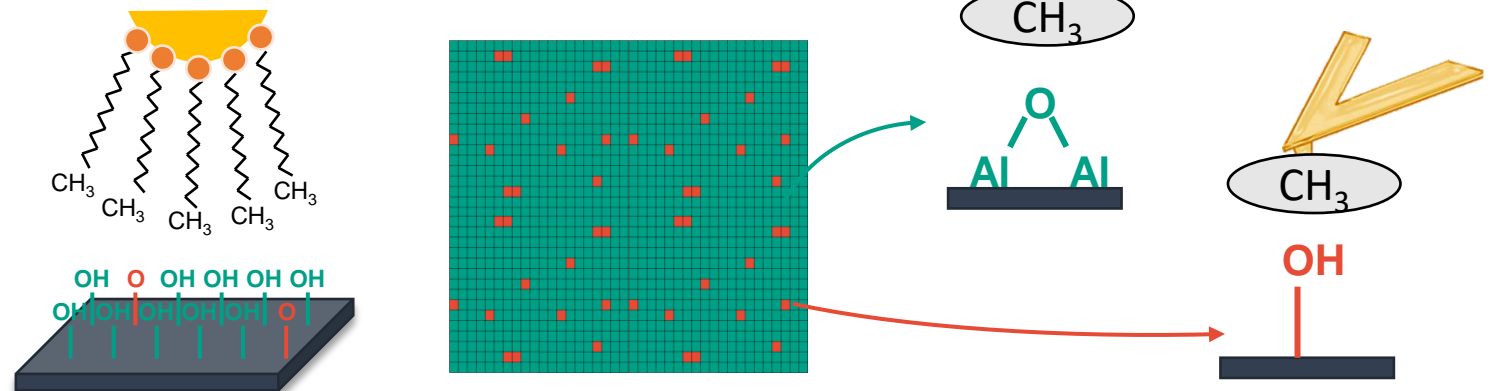
- Type of interactions



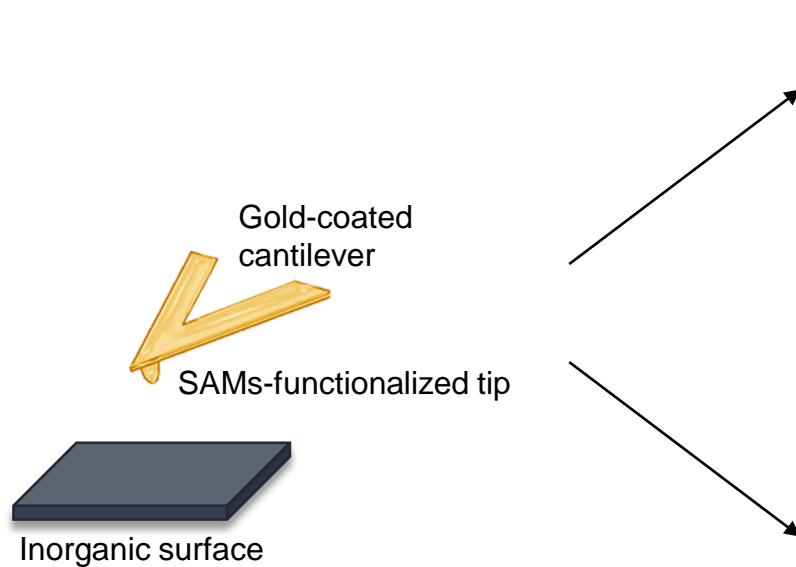
1/ Surface charge measurements



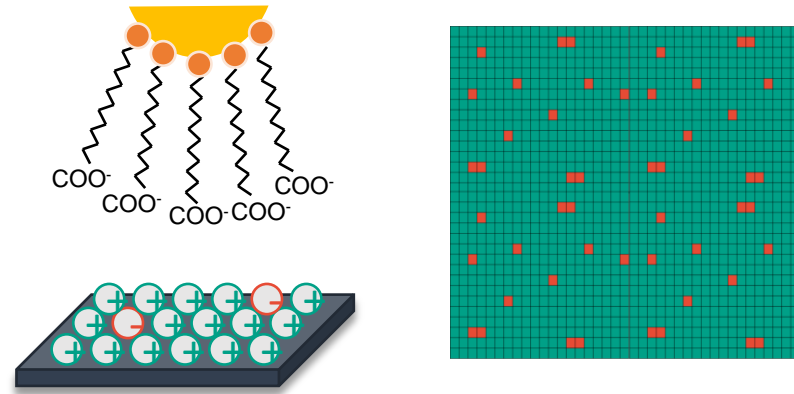
2/ Hydrophobicity measurements



Type of interactions

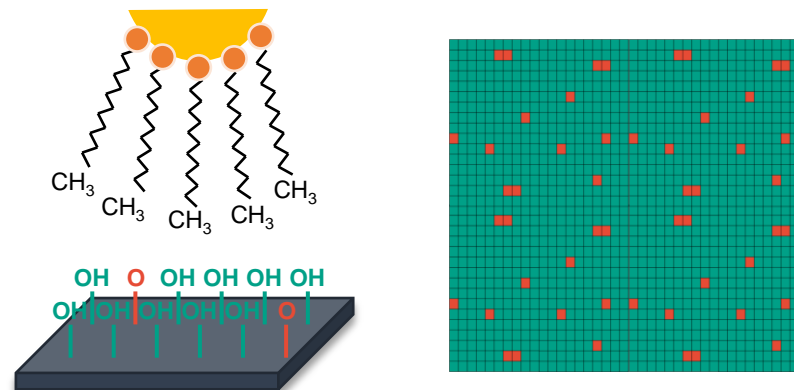


1/ Surface charge measurements



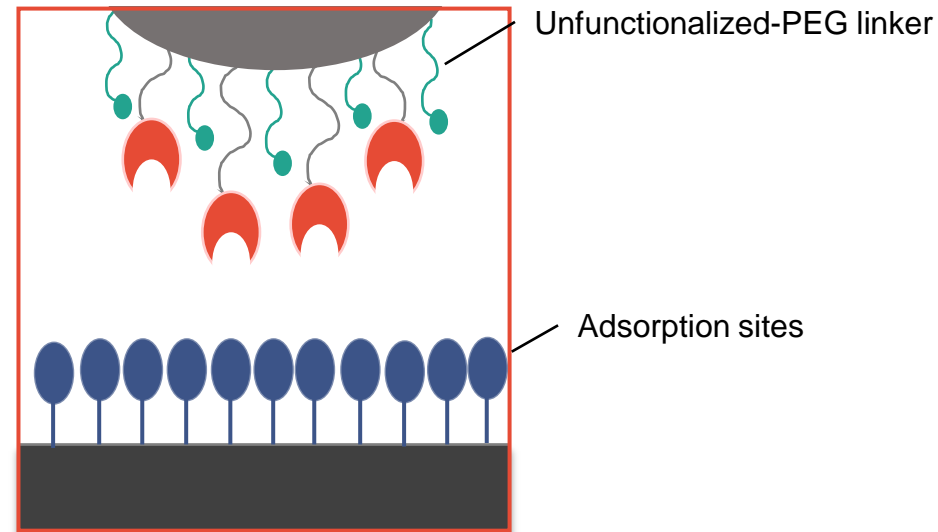
- Extraction of the **charge of the surface** at the studied pH
- **Mapping of positively-charged sites and negatively-charged sites**

2/ Hydrophobicity measurements

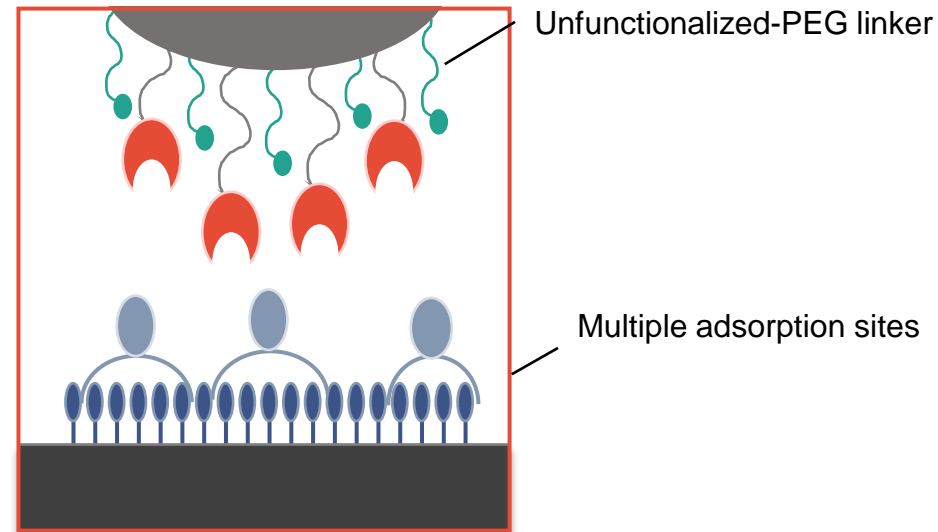


- Extraction of the **relative hydrophobicity** of the surface compared to control experiments
- **Mapping of hydrophobic sites**

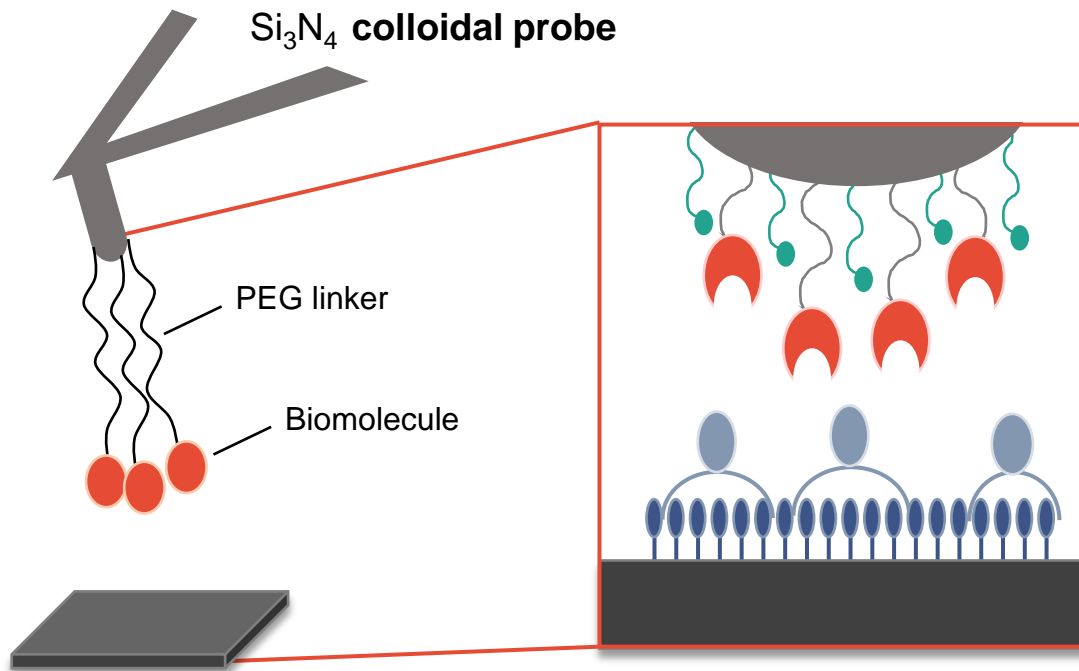
- Single molecule...



- **Single molecule... not single molecule ?**



- From single molecule to multivalency

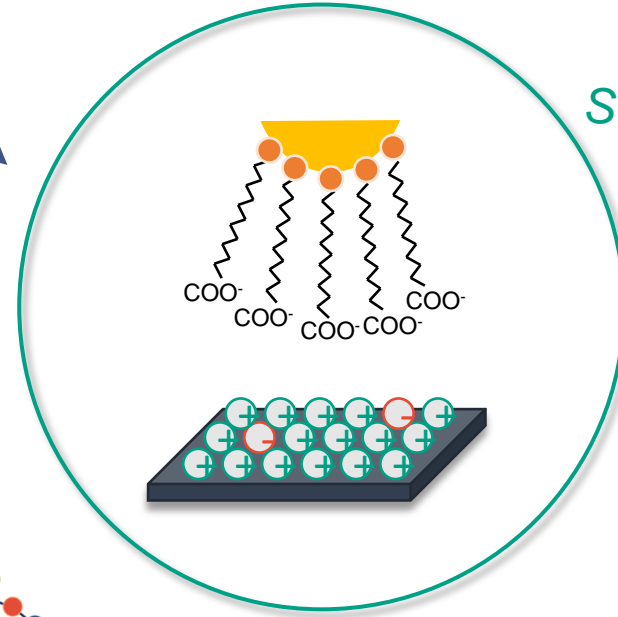
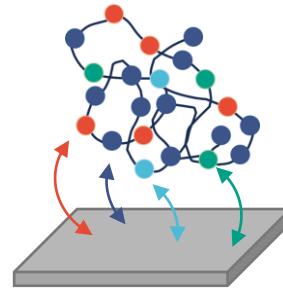
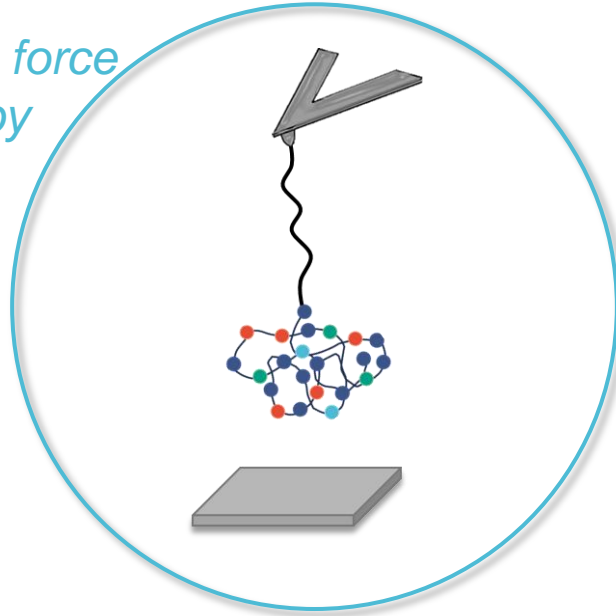


This data could allow us to extract the $\Delta_b G$, using **Jarzynski's model** as :

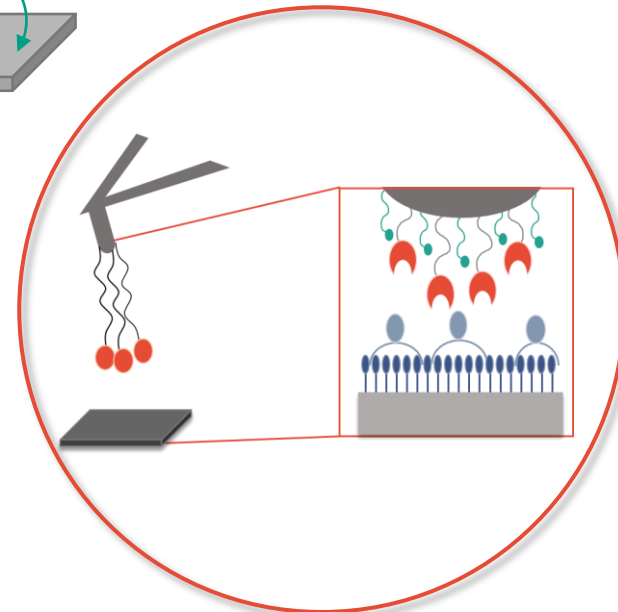
$$e^{-\Delta_b G/kT} = \langle e^{W_n/kT} \rangle_n$$

of the interaction in a **multivalent system**, while **avoiding molecule-molecule interactions**.

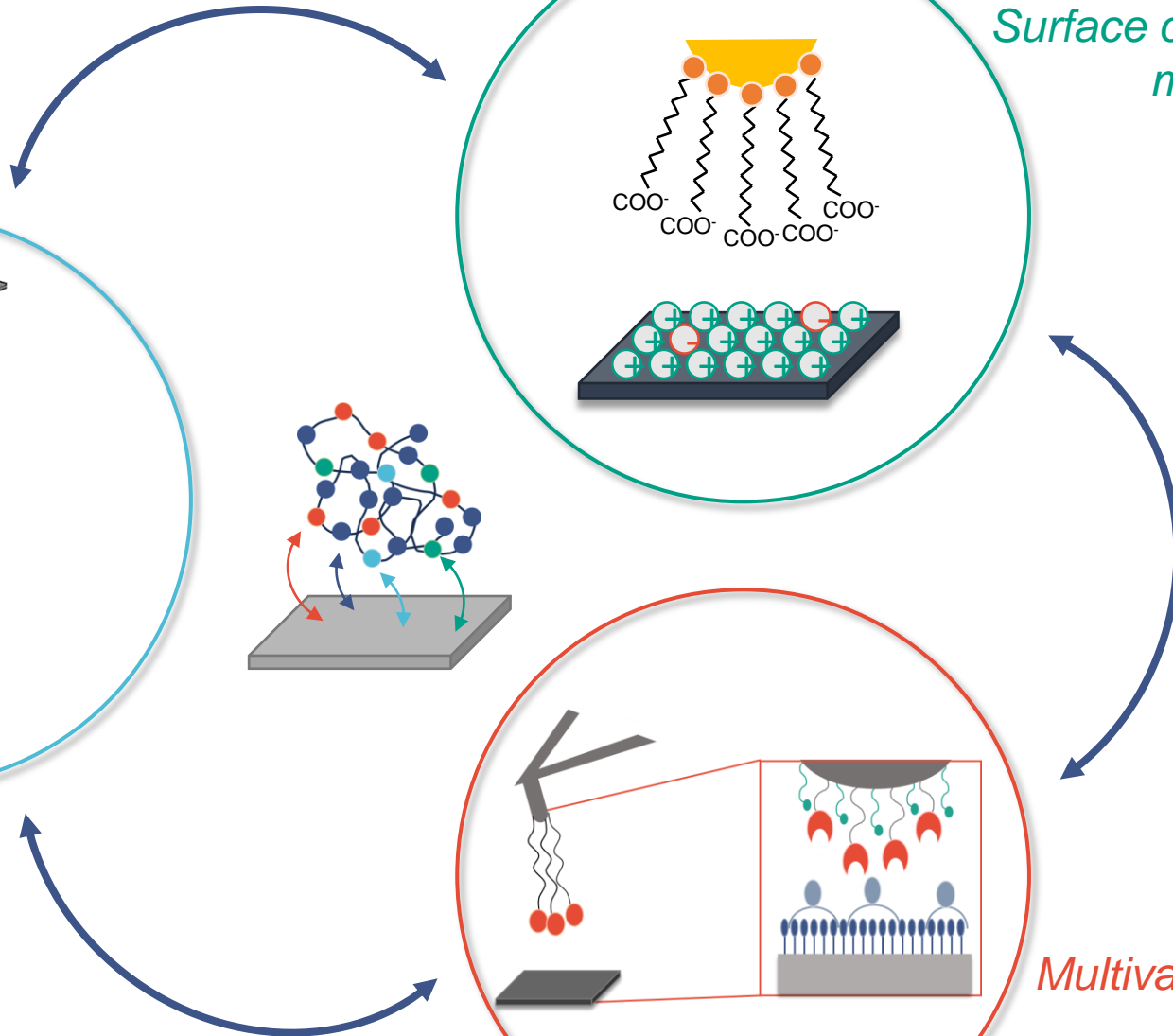
Single molecule force spectroscopy



Surface charge/Hydrophobicity measurements



Multivalency





ProMi team

Supervisors:
Dr. Jessem Landoulsi
Dr. Clément Guibert
Pr. Jean-François Lambert

PhD students:
Brittany Foley
Fanny Duhalde
Justine Ravaut

Post-doc:
Dr. Hédi Bouloussa

Thank you for your attention !