Influencing the nanostructures assembling by atmospheric pressure plasma

Speaker: Prof. Alessandro Patelli

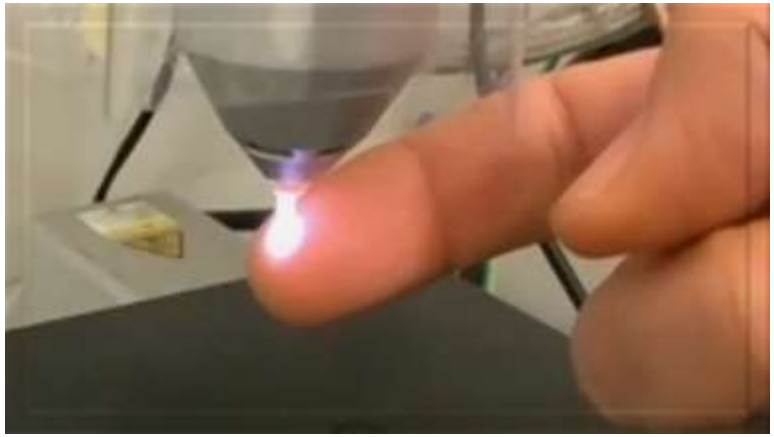
Group: Riccardo Fiorotto (PhD),
Eshan Shakerinasab (Postdoc),
Mattia Negrisolo (Assegnista)

Contacts

Speaker: Office n. 108 – Galileo Galilei Building, first floor
alessandro.patelli@unipd.it

Group: Riccardo Fiorotto (PhD),
Eshan Shakerinasab (Postdoc),
Mattia Negrisolo (Assegnista)

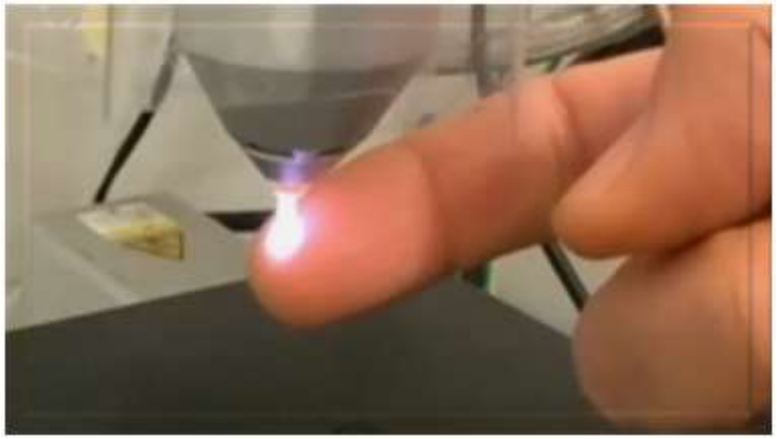
Cold plasma at atmospheric pressure



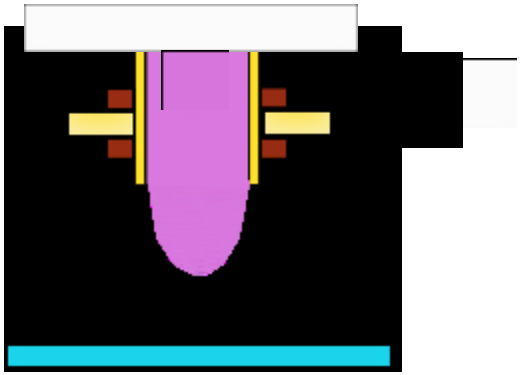
Plasma design and characterization

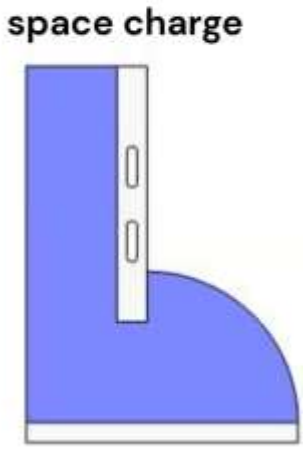
CFD simulations
Optical spectroscopy
Time resolved imaging
Electrical characterization

Cold plasma at atmospheric pressure



Time=0 µs

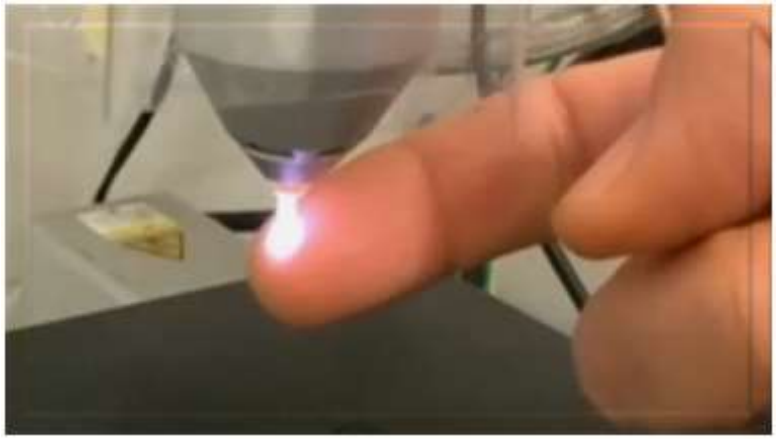


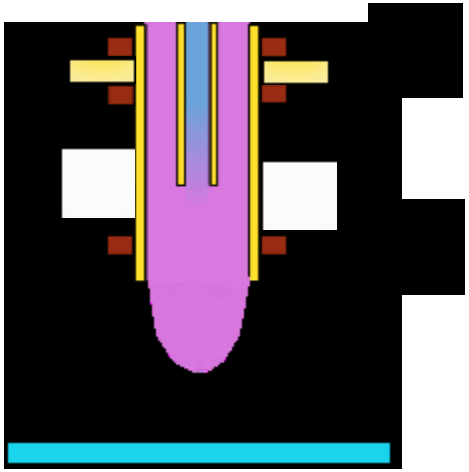


Streamers self-propagation

No control on ion fluxes

Cold plasma at atmospheric pressure

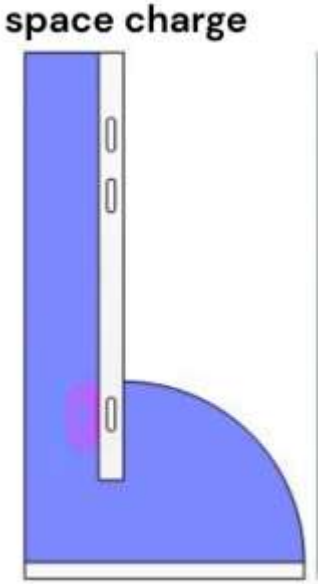




RF capacitive coupling

Glow plasma

Control on ions flux



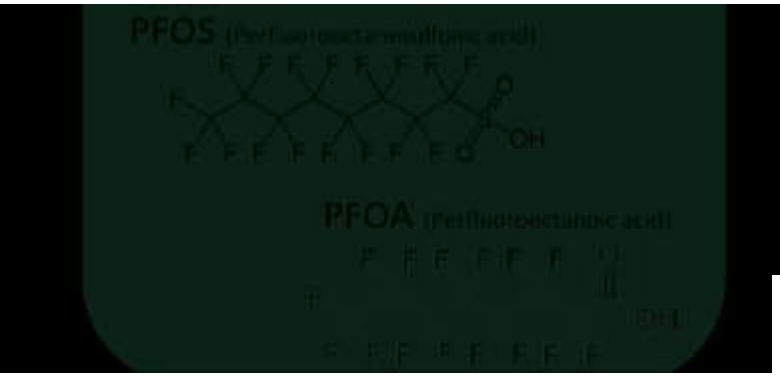
Running projects

Environment

- Regeneration of Granular Activated Carbon used for **PFAS removal** in water (SMARTGAC)
  (European Social Found 2024 – DISC-UniPD)
- **Vertically Oriented Graphene** Assembled Nanostructures for WATER purification (VOGA 'N WATER)
  (PRIN 2022 – CNR-ISOF / UniSS / UniPA)

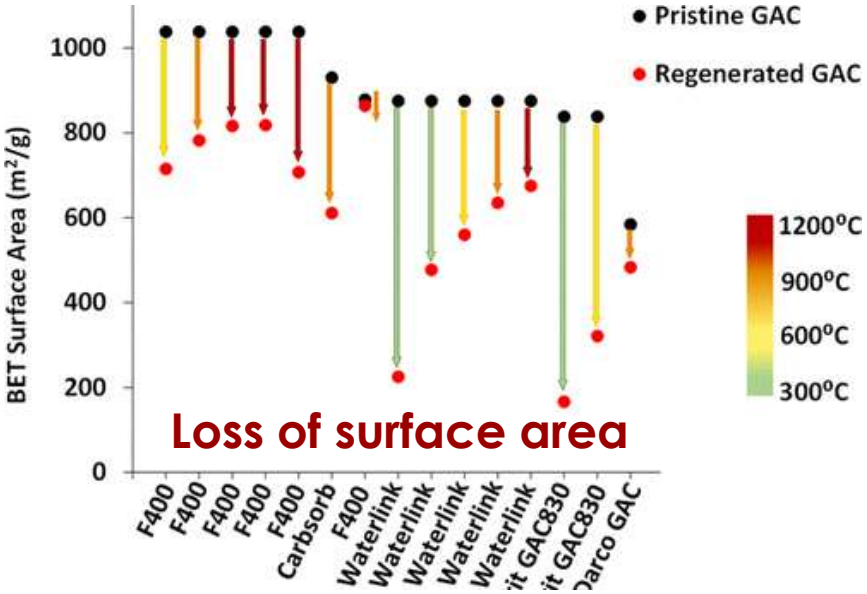
SMARTGAC

Fondo Sociale Europeo

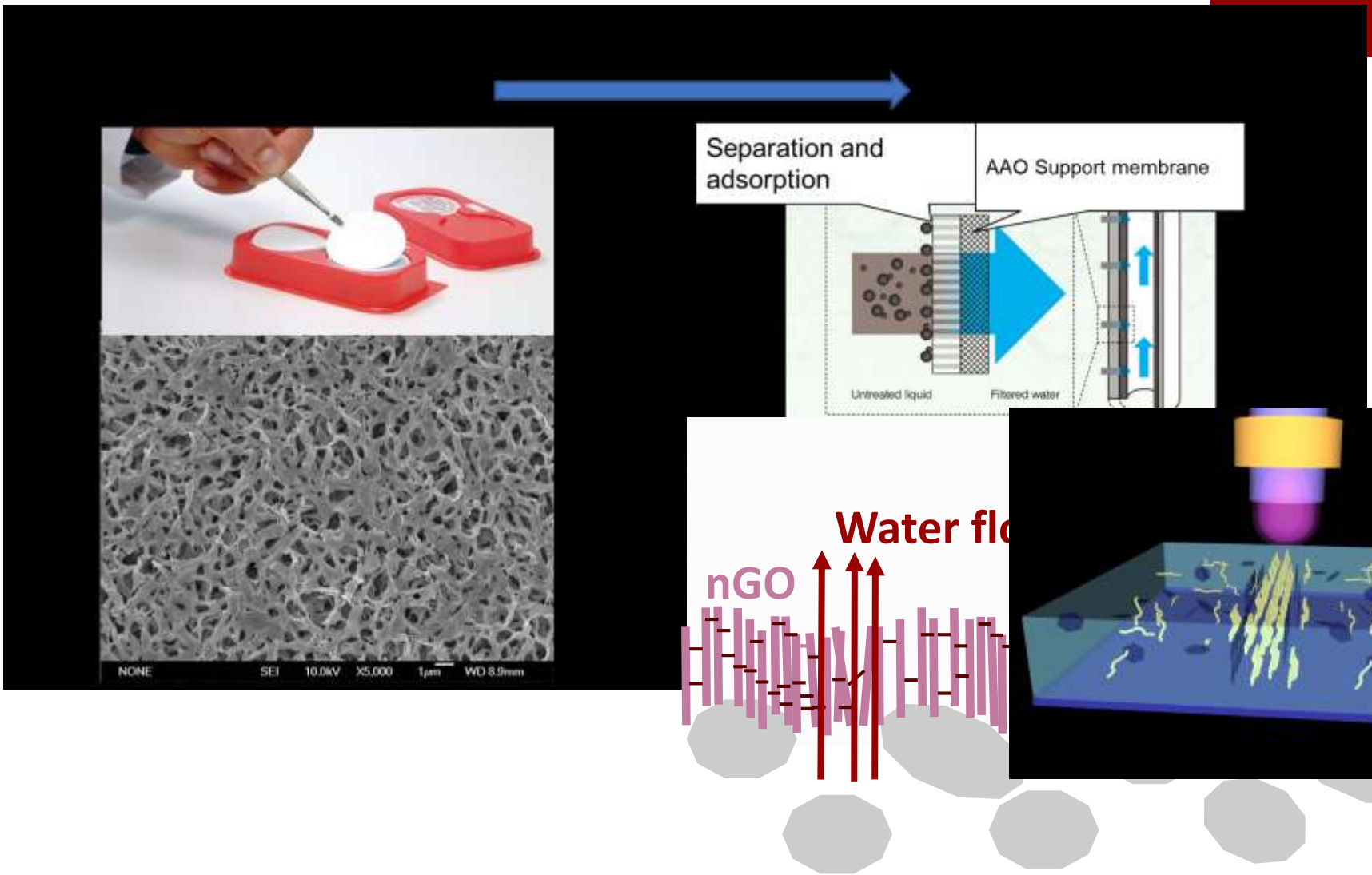


Regeneration of Granular Activated Carbon

Standard thermal treatment



VOGA 'N WATER


Separation and adsorption
AAO Support membrane
Untreated liquid
Filtered water
NONE
SEI
10.0kV
X5,000
1μm
WD 8.9mm
nGO
Water flo

Running projects

Environment

- Regeneration of Granular Activated Carbon used for **PFAS removal** in water (SMARTGAC)
  (European Social Found 2024 – DISC-UniPD)
- **Vertically Oriented Graphene** Assembled Nanostructures for WATER purification (VOGA 'N WATER)
  (PRIN 2022 – CNR-ISOF / UniSS / UniPA)

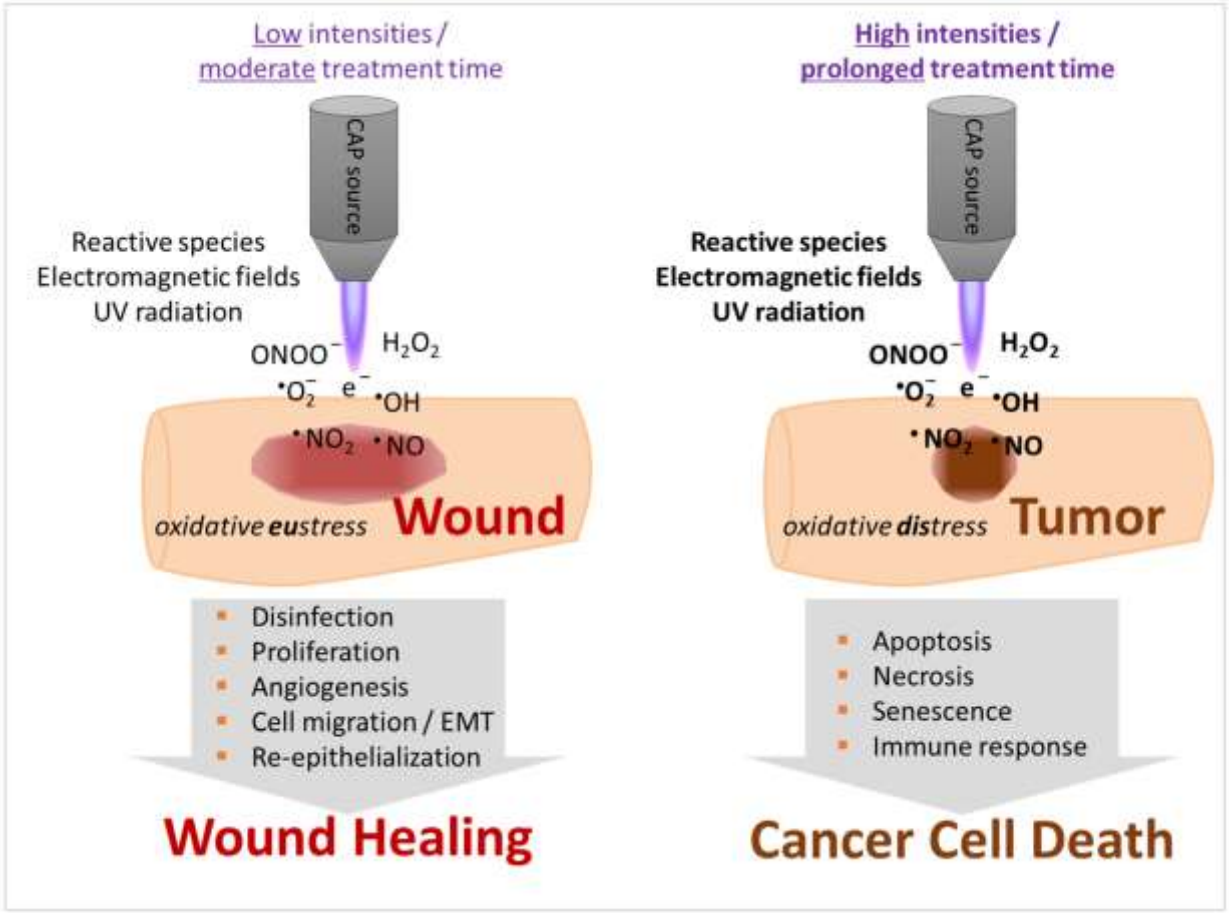
BioTech

- Surface treatments for **tissue regeneration**
  (Gerosa Medicine-UniPD / Susto DEI-UNIPD / Dettin DII-UniPD)
- Control of the **kinetics of self-assembling** nanostructures by atmospheric pressure plasma
  (iNEST Ecosistemi PNRR – Spoke 5 RT 1)

Plasma dose definition

Plasma can be safely applied to cells and living tissues.

- stimulation of cell division and differentiation
- the induction of different cell death pathways



How much ??

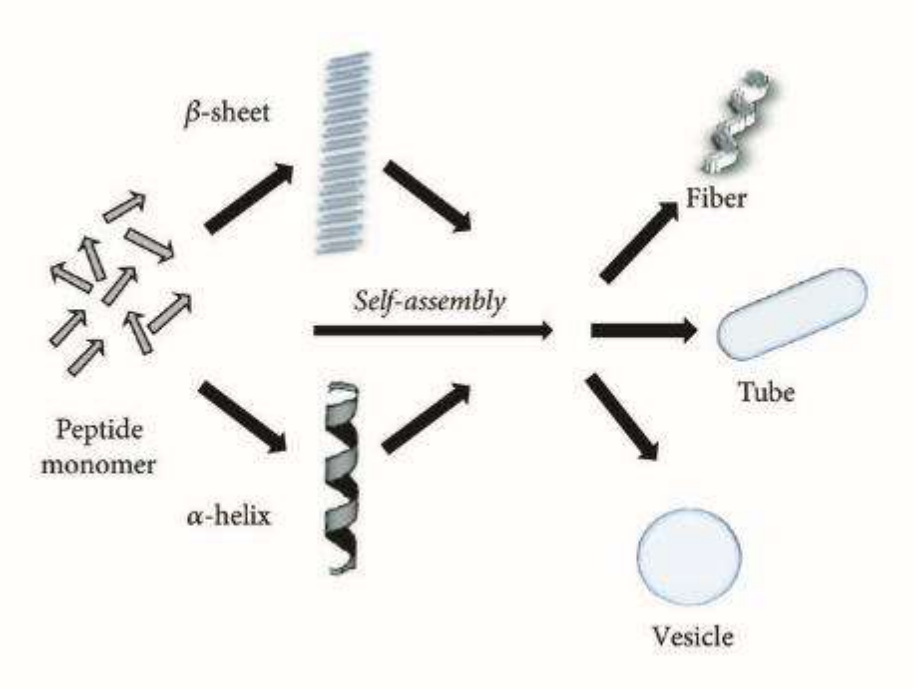
Collaboratio with Prof. Susto (DEI)

- Plasma real time monitoring
- Unsupervised machine learning algorithms for anomaly recognition.
- eXplainable Artificial Intelligence methods to enable root cause analysis during monitoring.

Drug delivery

Peptide Self-Assembled Nanostructures

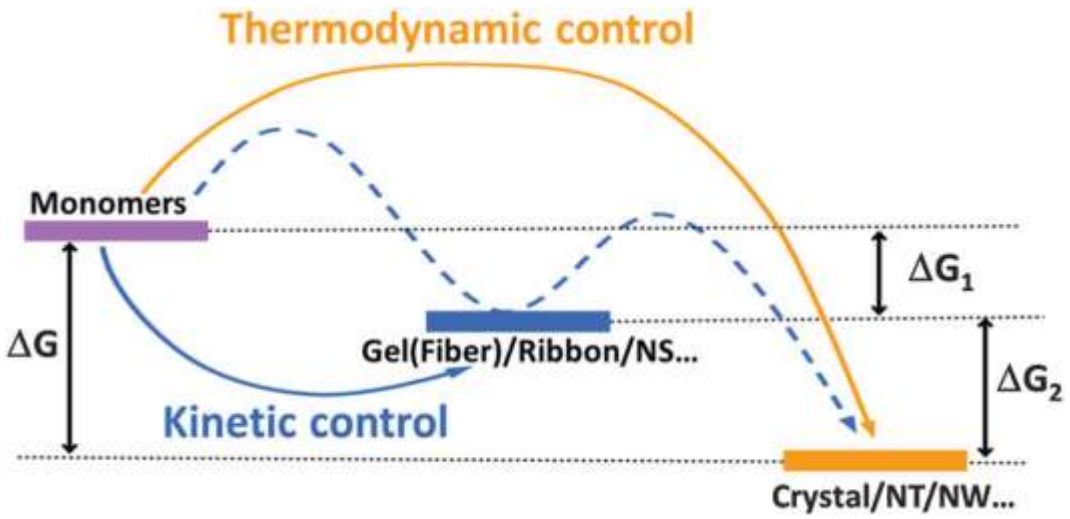
Peptide = amino acid chains



The tremendous advantages :

- good biocompatibility
- low cost
- tunable bioactivity
- high drug loading capacities
- chemical diversity
- specific targeting
- stimuli responsive drug delivery at disease sites.

Peptide assembling



For selected kinetic parameters, assembled structures can be trapped in metastable states.

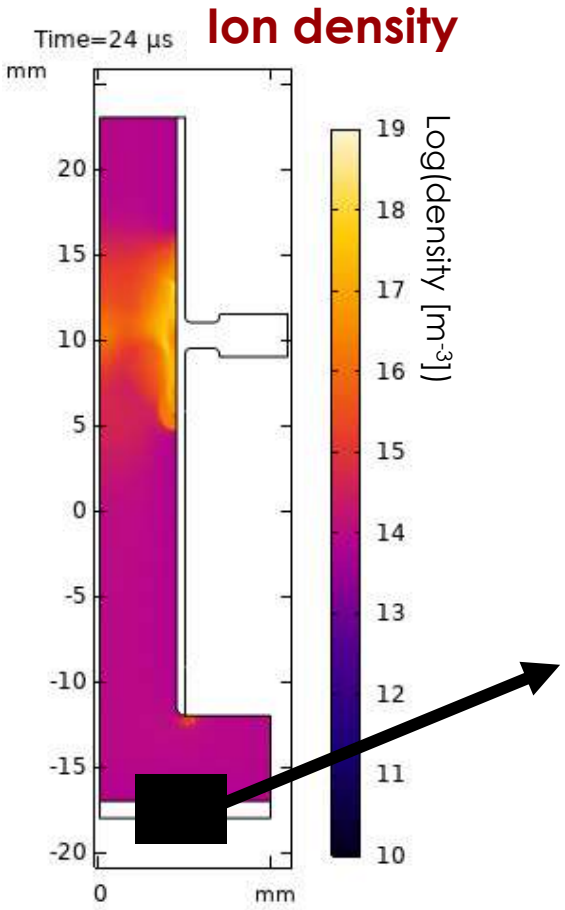
Kinetic parameters

- pH
- Temperature
- Counter-ions
- Concentrations
- Solvents

Thermodynamic driven process

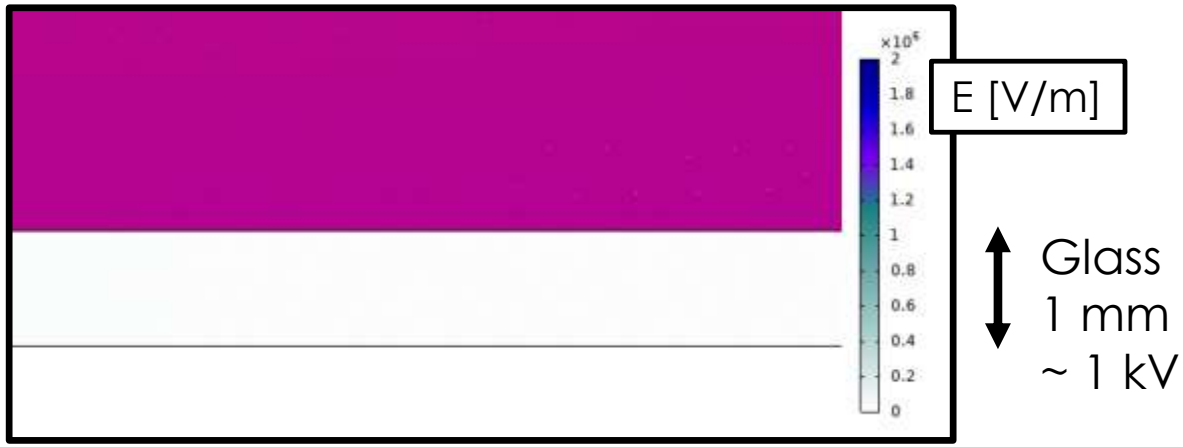
- Hydrogen bonding
- π–π stacking
- Electrostatic interaction
- Hydrophobic interaction
- van der Waals interaction

New kinetic parameter



a **UNIQUE** environment:

Ion flux	~ 10^{16} $m^{-2}s^{-1}$
Electric field	~ 10^{6} V/m

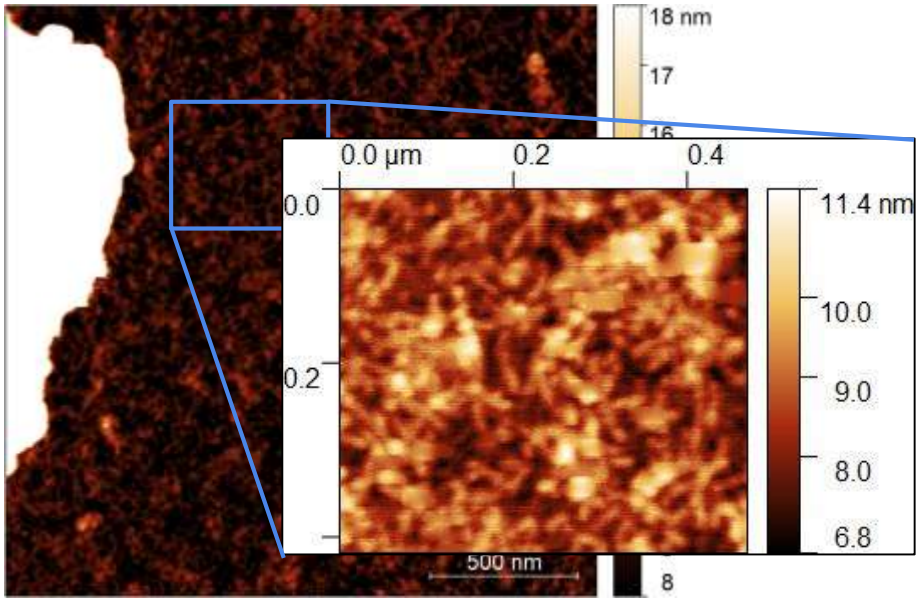


First results

EAbuK peptide

[redacted]

plasma



NO plasma