A Microfluidic Device for Real-Time Monitoring of Nanoparticle Biocorona Formation

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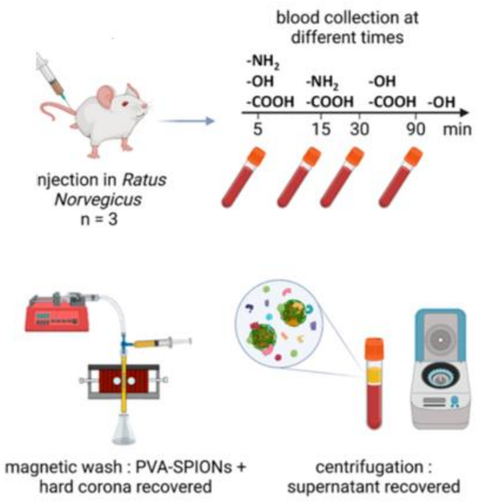
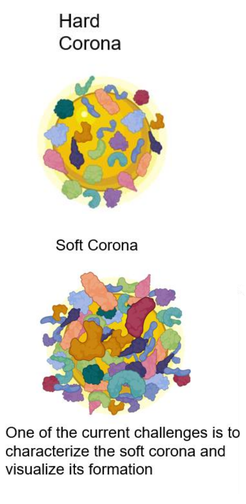
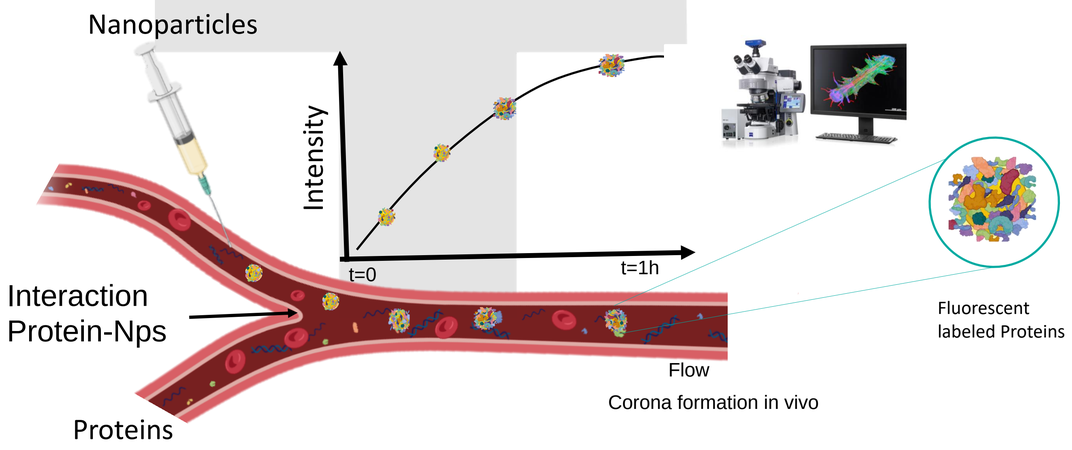
The research involves prototyping a microfluidic device to study and optimize nanoparticles interactions with blood proteins. Model nanoparticles will be selected, and their properties, such as protein adsorption, will be analyzed. Real-time analysis with fluorescence microscopy will observe nanoparticles behavior within the device. The study will also examine nanoparticle-protein interactions and the formation of protein coronas to improve targeted drug delivery and understand nanoparticle behavior in biological systems.

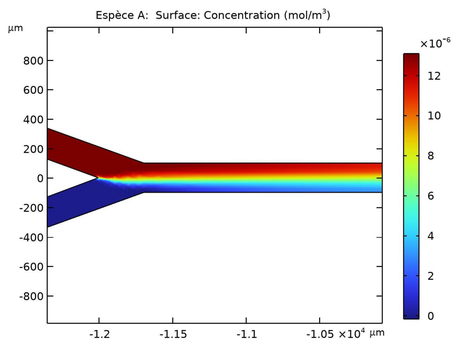


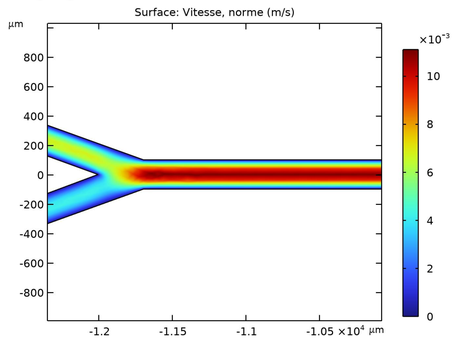


Innovative methodology



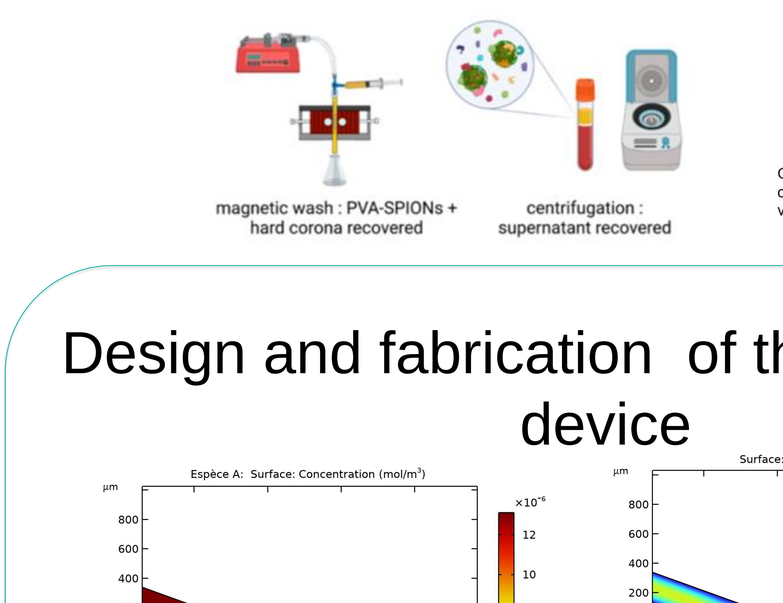
Design and fabrication of the microfluidic device

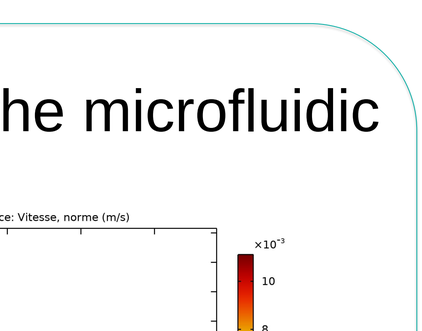




- Y-branch channel 3 cm long
- Height: 50 µm
- Width: 200 µm

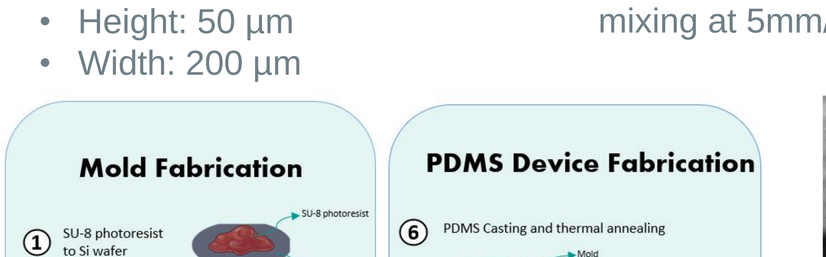
➢ The laminar flow ensures passive mixing at 5mm/s





- Reduction of particle adhesion on the microchannel surfaces

Particle tracking optimization

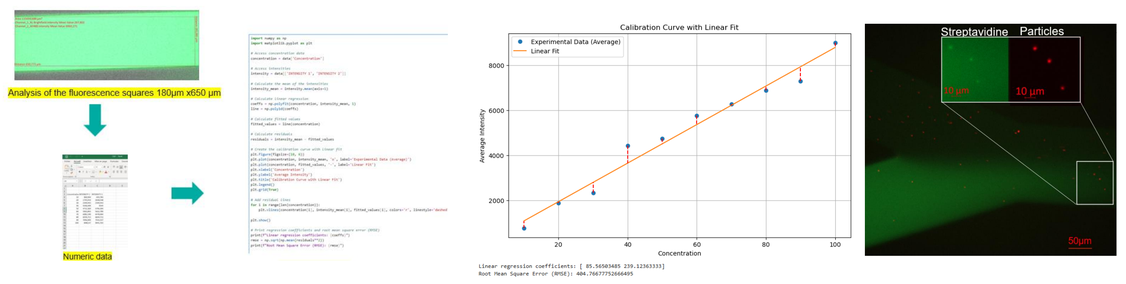


500 µg /mL 50 µg /mL 10 µg /mL

- Red fluorescent 900nm particles

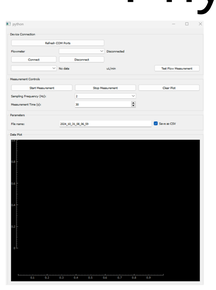
➢ 10 mg/mL at a flow rate of 5 µg/min provides the best conditions for particle monitoring.

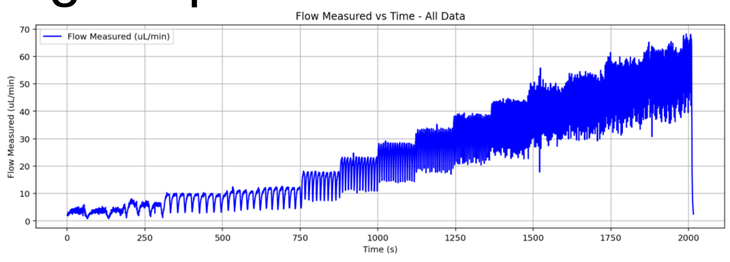
Data Acquisition and Processing



- Microscopic image analysis was used to create a calibration curve correlating protein concentration with signal intensity.

Physiological parameters



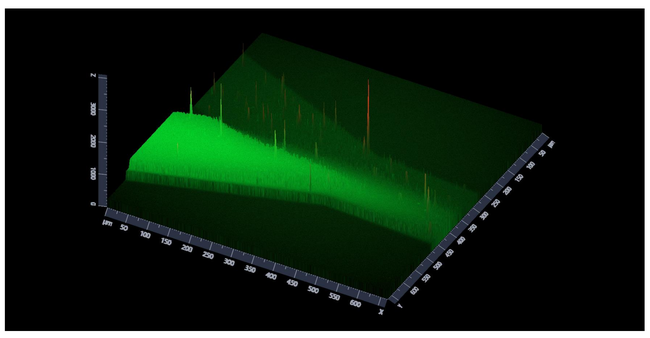


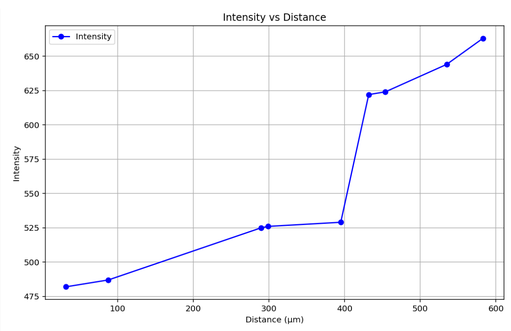
- Flow rates from the pump and data collection at different times.

→ This is important as soft and hard corona formation times differ.

→ Adjusting conditions let us observe changes in soft corona size.

Preliminary results and conclusions





- 3D plot of the increase in intensity in the channel- plot on the right shows intensity versus distance traveled

⟶ This is a preliminary result showing the increase in particles concentration over time within the microchannel

Perspectives:

❑ Track particles over longer periods.
❑ Experiments with different speeds and particle parameters
❑ Experiments of the interaction protein-NPs with more than one protein

Bibliography

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- ACS Nano 2023 17 (13), 12458-12470

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