

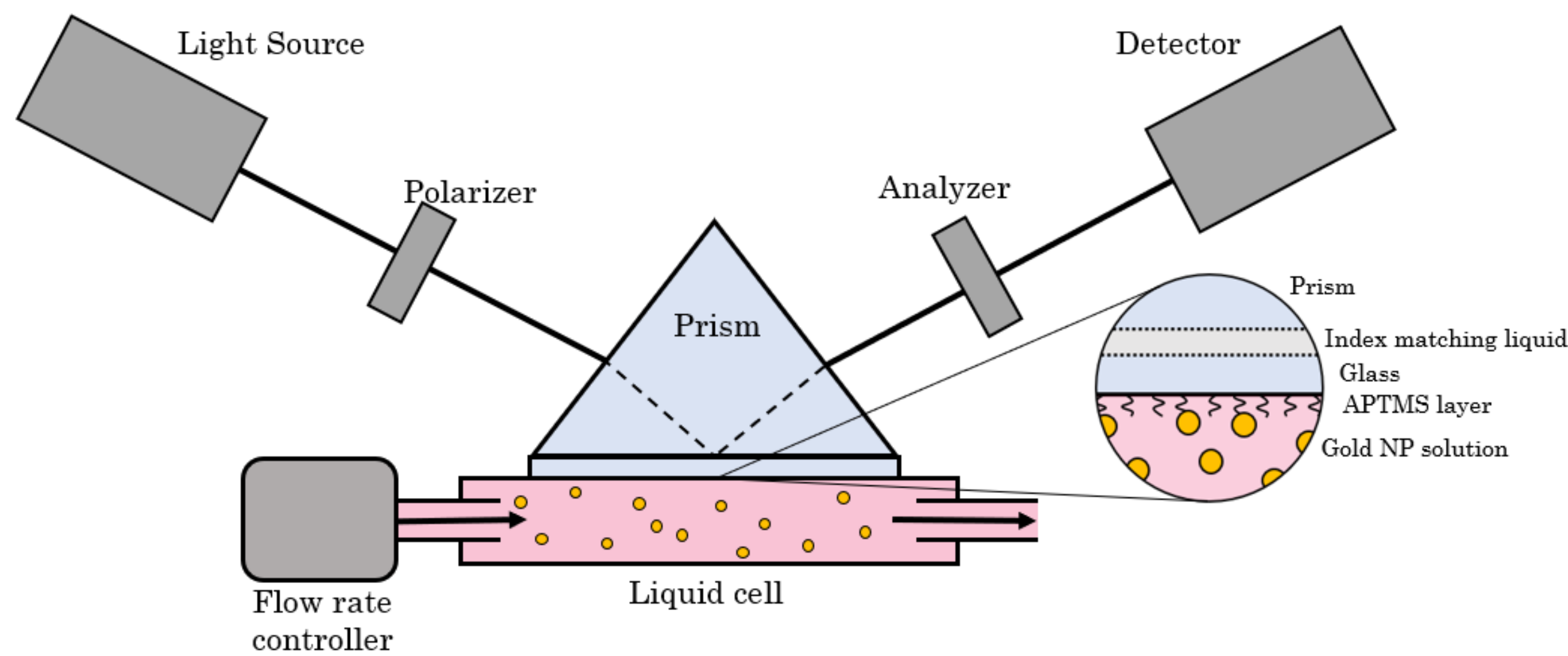
Adhesion Kinetic Study of Gold Nanoparticles Functionalization using APTMS by Total Internal Reflection Ellipsometry (TIRE)

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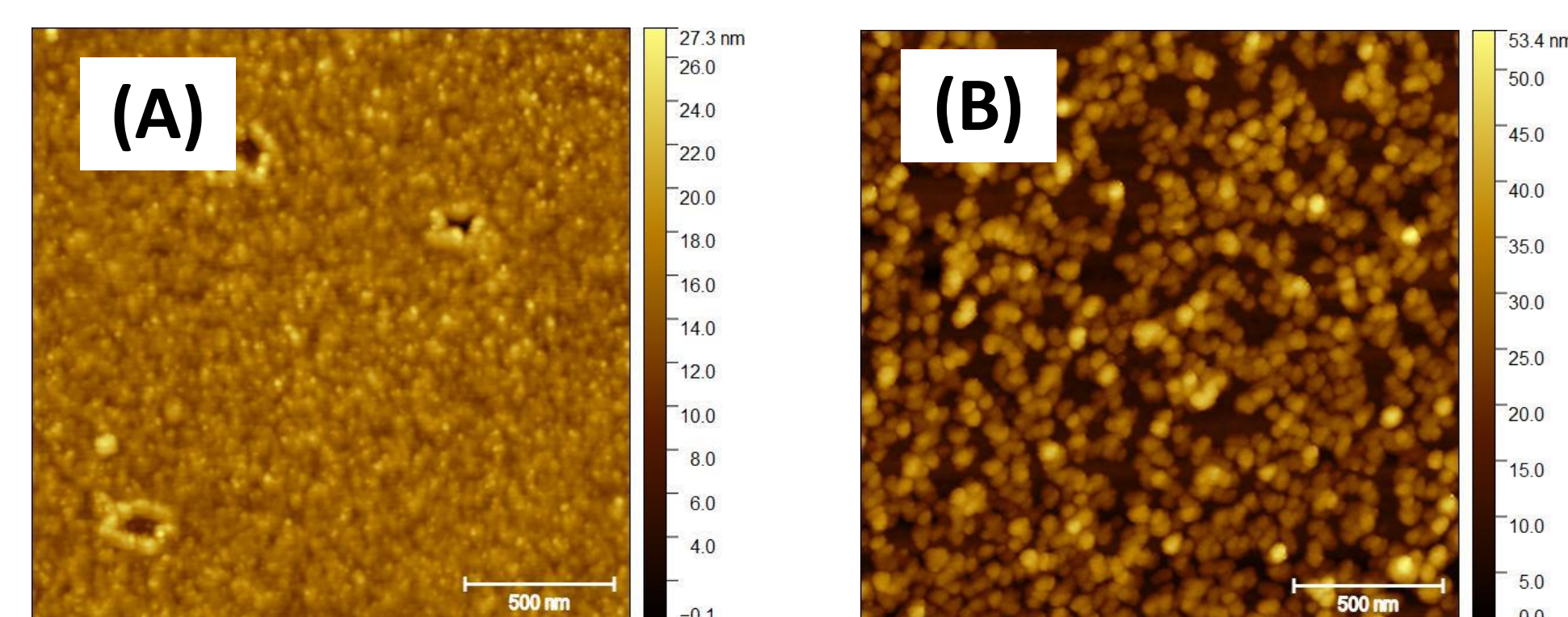
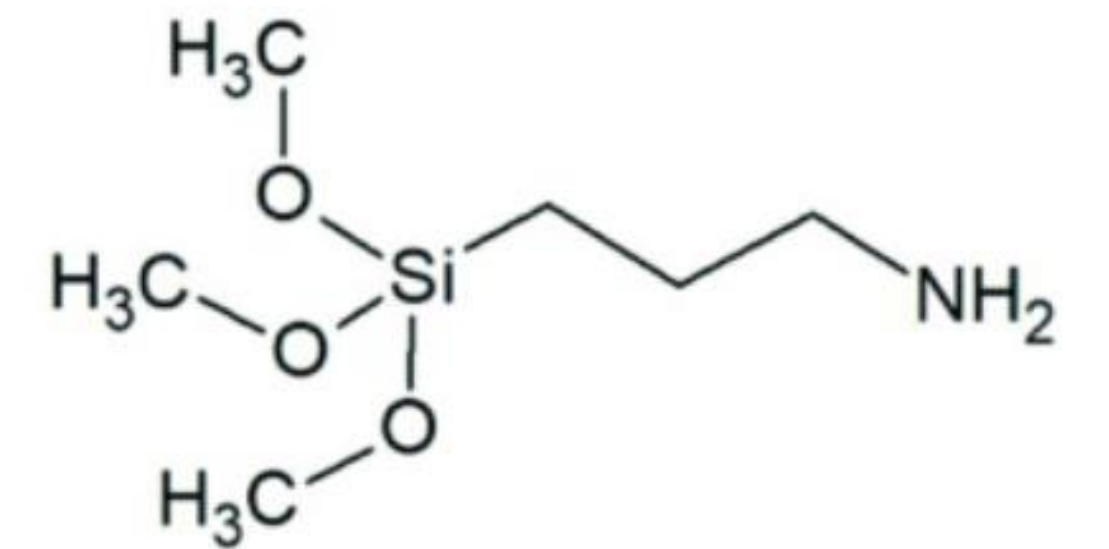
Optical response of Au nanoparticles monolayer formation in real time using TIRE experiment

Material and Method



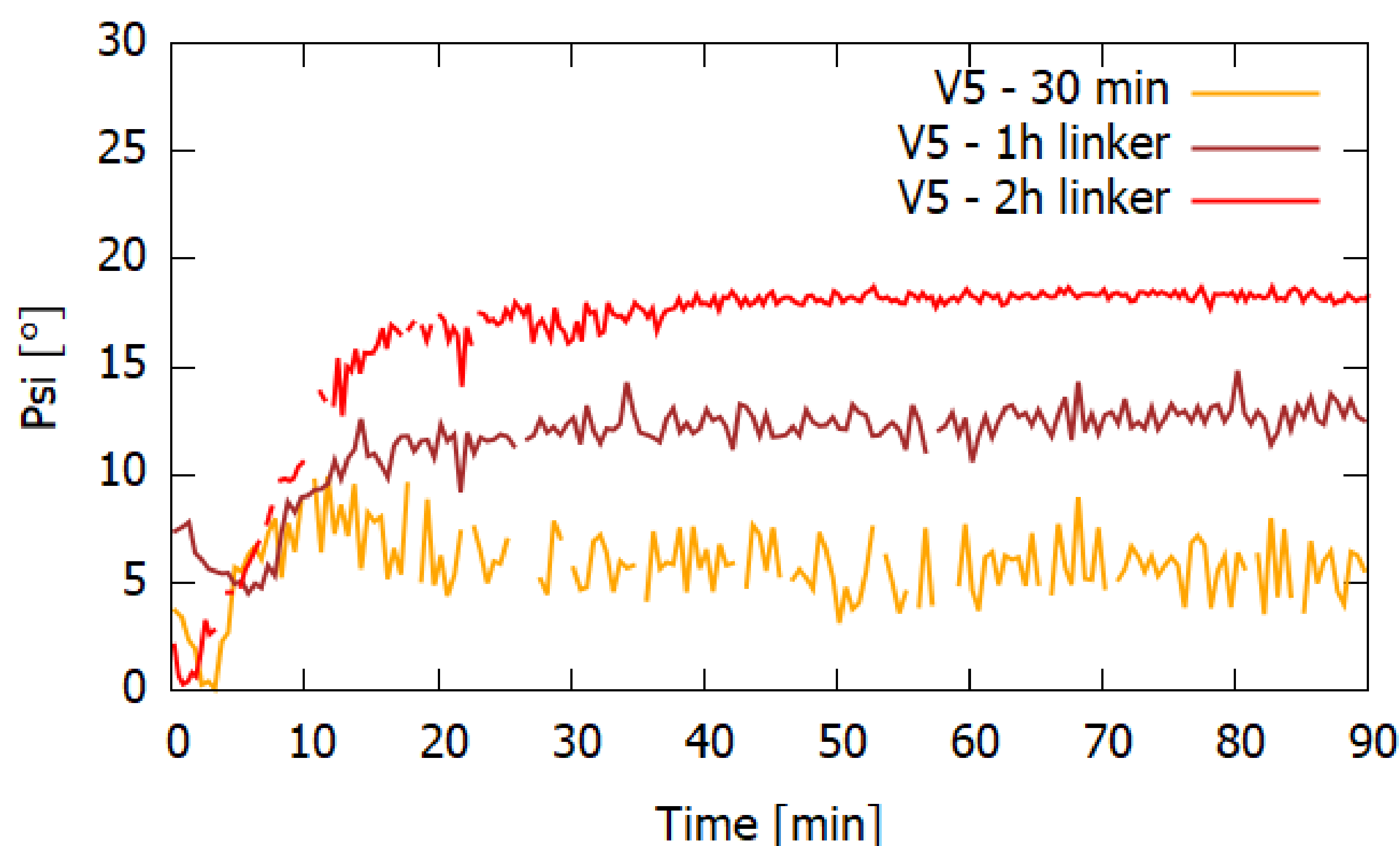
Accurion EP3-SE in Kretschmann configuration to reach a total internal reflection at the glass-liquid interface
→ High optical sensitivity

1. Silicon and glass samples are functionalized by dipping in a (3-Aminopropyl)trimethoxysilane (APTMS) solution for different time periods (30 min, 1h, 2h)
2. A colloidal solution of gold nanoparticles (GNPs) passes through the liquid cell with different flow rates (V1 : 0.03 mL/min, V5 : 1.8 mL/min, V10 : 3 mL/min)



(A) APTMS surface on glass after 120 min
(B) Unoptimized GNPs layer on glass

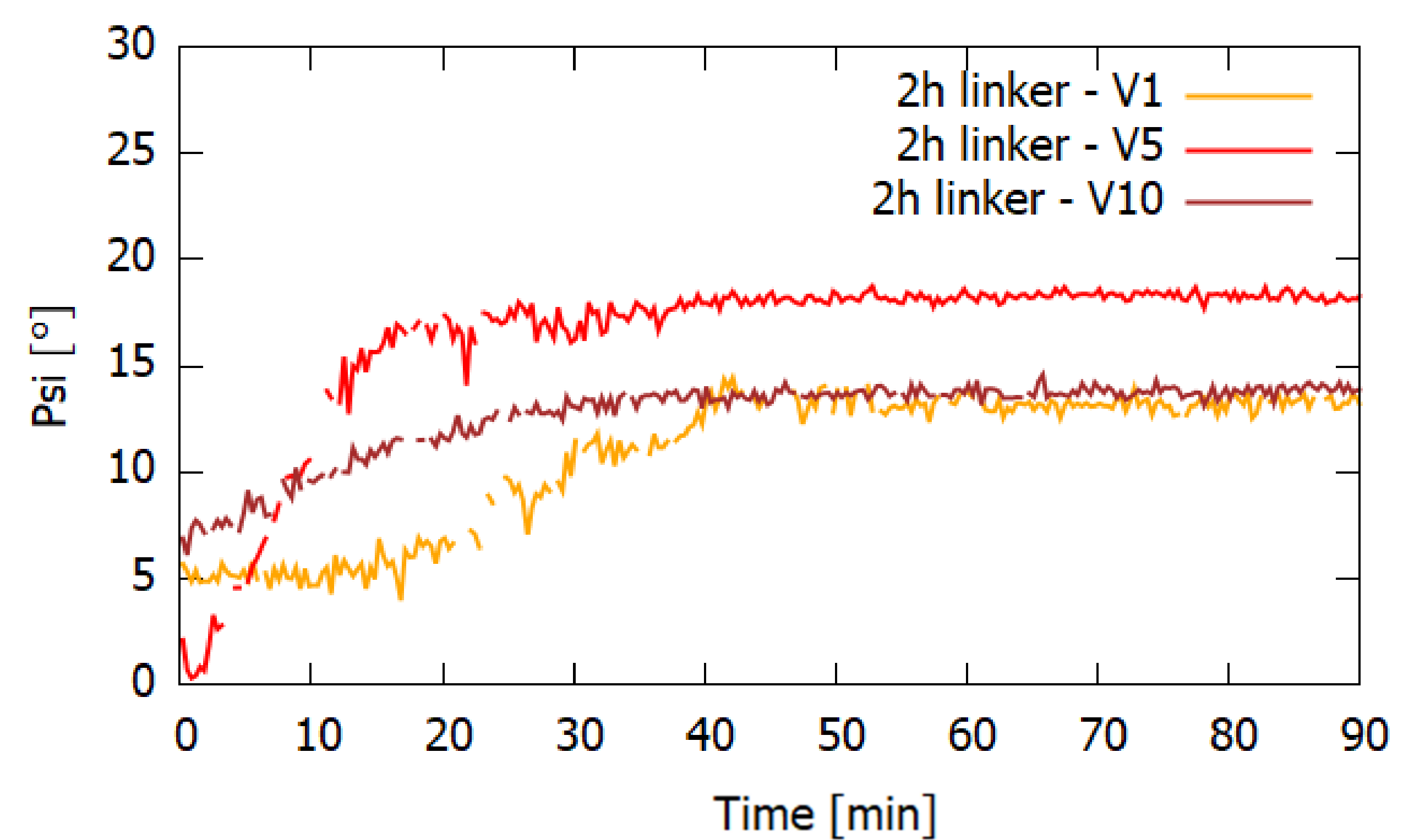
APTMS Influence



Experimental ψ at 520 nm and AOI 43° according to real time for different APTMS dip with a fixed flow rate.

- Adhesion kinetics is **not influenced** by the APTMS duration
- APTMS duration changes the **amount of NPs** bound to the surface

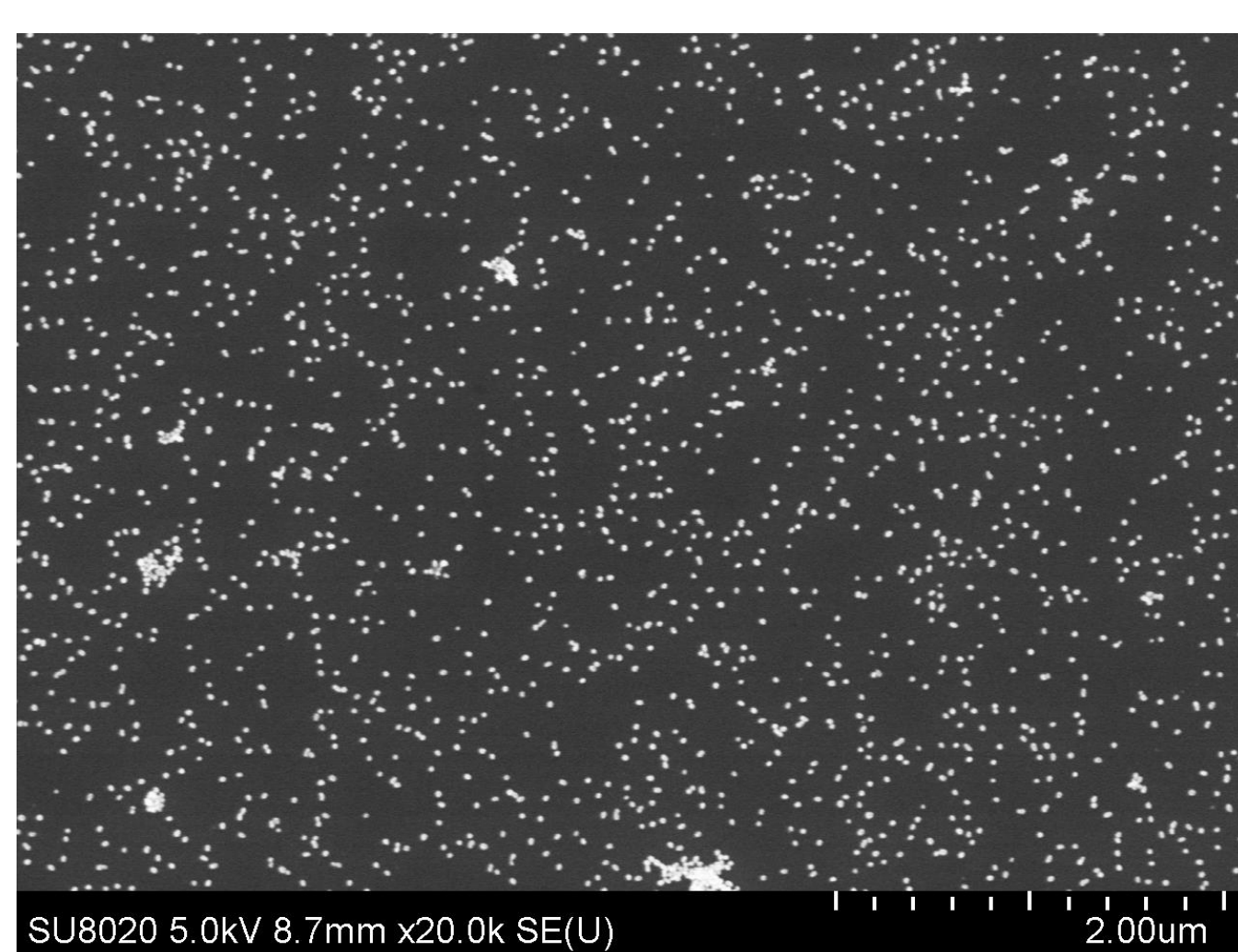
Flow Rate Influence



Experimental ψ at 520 nm and AOI 43° according to real time for different flow rate with a fixed APTMS dip.

- Adhesion kinetics and the number of NPs is **influenced** by the flow rate though a diffusion-controlled process

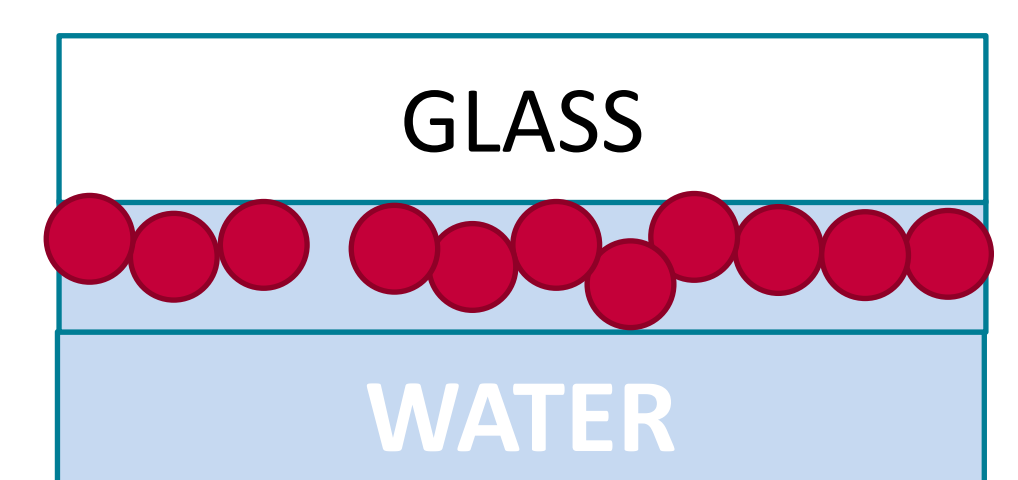
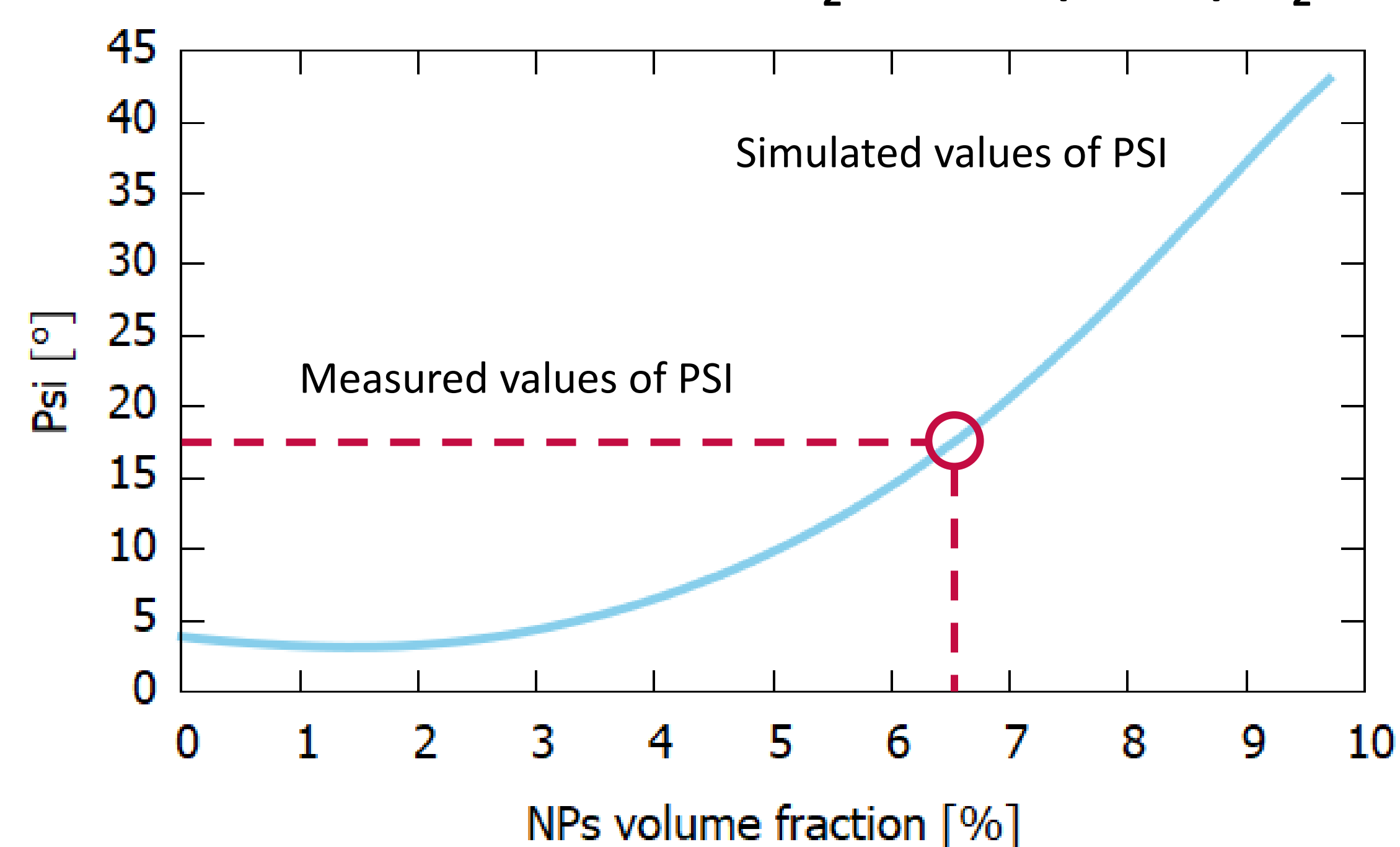
SEM image vs ellipsometry simulated data



SEM image of Au NPs monolayer on silicon after 2h of APTMS and 90 min of NPs solution at a V5 flow rate

- Image analysis of SEM pictures indicates a **volume fraction of 6%**

Simulated model : BK7/H₂O+AuNP(20nm)/H₂O



- **Good agreement** between simulated and experimental data
- Simulated ψ values can be used to **directly estimate the NPs volume fraction**

Conclusion

- Optimal parameters for the adhesion of NPs have been identified through the TIRE experiments
- Simulations show a good matching with experiment