FORMATION OF GOLD NANOPARTICLES UNDER A MONOLAYER OF IONIC LIQUID

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The use of an ionic liquid (IL) as electrolyte is promising for very high capacity energy storage units based on graphene electrode [1]. Moreover, introducing gold nanoparticles (NPs) at the interface between the IL and the electrode makes it possible to increase the capacitance [2]. We study the interface between these NPs and a layer of the $[C20mim]^+[NTf2]^-$ IL. We use x-rays surface radiolysis [3] to produce gold NPs under a Langmuir film of $[C20mim]^+[NTf2]^-$ deposited on an aqueous sub-phase containing gold ions [4]. The formation of gold NPs is obtained by irradiating the surface with the x-rays which simultaneously allows in following their growth and the structural transformations in the film. The films characterization was carried out on the liquid sub-phase by thermodynamic (surface pressure versus surface density isotherms), surface x-rays scattering measurements at the SOLEIL synchrotron and AFM measurements on films transferred on solid substrates before and after irradiation. We observe that both the film thickness and *r*, the gold ion/IL molecule ratio, are key factors for the formation of the gold NPs: at a low ratio (r = 30), gold NPs of about 15 nm in diameter are obtained. On the other hand, for a high ratio (r = 600), we observe the appearance of a superstructure in the monolayer but no formation of NPs. The exchange between $AuCl_4^-$ (in the subphase) and $^+[NTf2]^-$ appears to be the element preventing the possibility of forming gold NPs anchored under the layer [5].

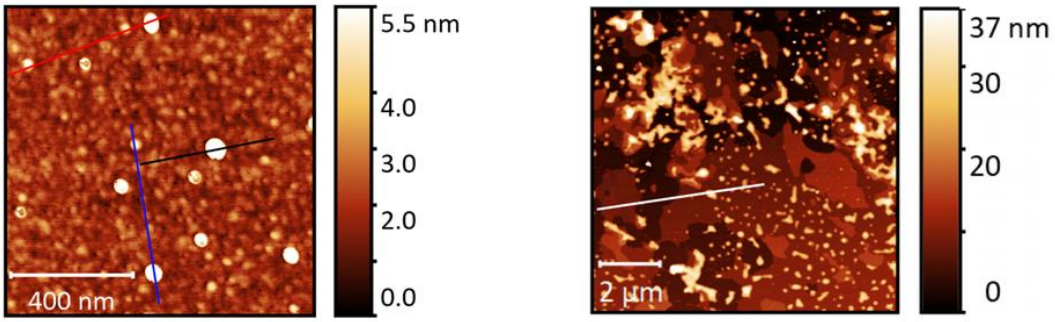

Figure: AFM image of $([C20mim]^+[NTf2]^-$ monolayer transferred on a silicon wafer after 8 hours of irradiation. a) r = 30, presence of gold NPs, b) r = 600 no gold NPs

References

[1] W. Raza et al , *Nano Energy*, **2018**, *52*, 441.
[2] M. Sarno et al, *Journal of Physics and Chemistry of Solids*, **2018**, *120*, 241.
[4] F. Muller et al, *Langmuir*, **2004**, *20*, 4791.
[5]G. Diot, *PhD Thesis, Sorbonne Université* **2023**.