M2 Research internship

Vapor nanobubbles for solar energy conversion

Solar energy is by far the most dominant renewable energy source available to everyone. Sunlight absorbers have been recently proposed for direct conversion of liquid water into vapor [1]. Solar vapor generation can solve critical societal issues such as water purification and desalination in developed countries and water stressed areas, where 60% of world population will live by the year 2025. Solar to vapor conversion efficiency depends crucially on the formation and growth of vapor nanobubbles around sunlight irradiated nanoparticles. The peculiar properties of vapor nanobubbles make them also interesting for a range of applications including cancer cell therapy. Yet, a fundamental understanding of their prime properties is still very partial due to the different physical mechanisms that compete (surface tension, heat transfer, phase transition).

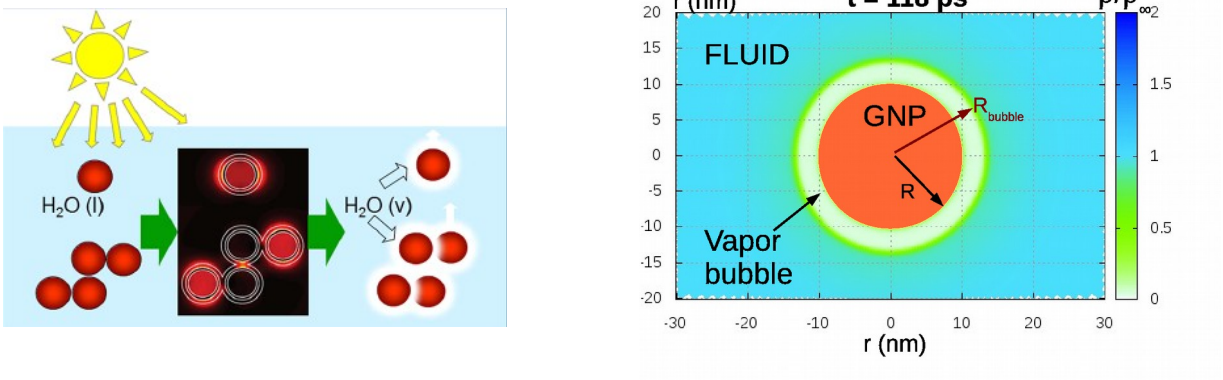

Figure: Left: Solar vapor conversion assisted by metal nanoparticles [1]. Right: Nanobubble simulated around a laser heated nanoparticle in water [2].

The aim of this internship is to quantify theoretically nanobubble growth following sunlight nanoparticle irradiation. The successful candidate will run a finite difference code that we wrote to simulate the formation of nanobubbles around laser heated nanoparticles [2]. The work is essentially numerical, but parallel analytical modeling is also possible. This topic is of full interest for colleagues working at the CETHIL (Centre de Thermique de Lyon) laboratory on the campus INSA La Doua.

[1] O. Neumann et al., "Solar vapor generation enabled by nanoparticles", *ACS Nano* 7 (2012) 42

[2] J. Lombard, T. Biben and S. Merabia, « Kinetics of Nanobubble Generation Around Overheated Nanoparticles », *Phys. Rev. Lett.* 112 (2014) 105701 ; J. Lombard, T. Biben and S. Merabia, « Ballistic heat transport in laser generated nanobubbles», *Nanoscale* 8 (2016) 14870

Opening toward a PhD : yes (funding with «bourse ministère»)

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