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Nanoparticles used for biological applications (e.g. optical imaging or sensing) can only be relevant if one controls their chemical surface properties (e.g. hydrodynamic size, the difference of potential, coating chemical nature) [1,2]. For applications like drug delivery or imaging ones for instance, nanoparticles indeed need to promote an efficient diffusion in complex and heterogenous biological environments. This means that several biological barriers including the physiological one and the formation of the protein corona must be understood.

Here, we focus on semiconducting single-walled carbon nanotubes which display advantages for imaging applications, such as near-infrared photoluminescence (biological window), photostability and high tissue penetration ability due to their nanoscale 1D morphology [3,4]. In this work, we investigate how nanotubes coating – such as phospholipids with different polar head groups or one strand DNA, linked or not to methoxy PEG of varying sizes - impacts their diffusion within two models. One model mimicking the extracellular matrix: the Matrigel, a reconstructed gel extracted from mice sarcoma ; And the second one, an *ex-vivo* model with mice livers.

Following the characterisation of each carbon nanotube suspension, single nanotube tracking within the two different models is realized to compute a super-resolution map of the local environment to retrieve the diffusion properties of the nanoparticle [5]. In the case of mice livers, we employ a correlative microscopy strategy to identify the *in situ* biological environment surroundings (cells membranes and nucleus) the nanotubes to further help identifying the microenvironment.

References

[1] Luise Tomasetti et al, *European J. of Pharmaceutics and Biopharmaceutics*, **2016**, Vol 108, 145-155.

[2] Mengxiao Yu, Jie Zheng, *ACSNano*, **2015**, Vol 9, 6655-6674.

[3] Antoine G. Godin et al, *Nature Nanotechnology*, **2016**, Vol 12, 238-243.

[4] Chiara Paviolo, Laurent Cognet, *Neurobiology of Disease*, **2021**, Vol 153, 105328.

[5] Chiara Paviolo et al, *Methods*, **2020**, *Vol 174*, 91-99.