SINGLE CARBON NANOTUBE TRACKING REVEALS LIVE BRAIN EXTRACELLULAR SPACE NANOSCALE ORGANISATION

N. Danné[1,2], A. G. Godin[1,2], J. Varela[3,4], Z. Gao[1,2], J. Dupuis, B. Lounis[1,2], L. Groc[3,4] and L. Cognet[1,2]

[1]University Bordeaux, Laboratoire Photonique Numerique et Nanosciences, Talence, 33400, FRANCE

[2] Institut d'Optique & CNRS, LP2N, Talence, 33400, FRANCE

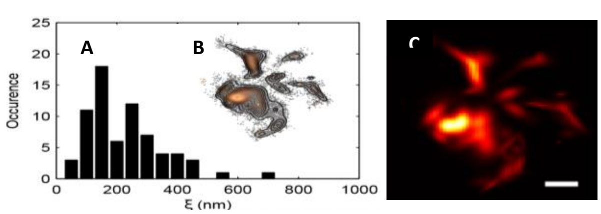
[3] University Bordeaux, Interdisciplinary Institute for Neuroscience, Bordeaux, 33000, FRANCE

[4]CNRS, IINS, Bordeaux, 33000, FRANCE

The complex biological network composing the brain is a highly dynamic structure in which the extracellular space (ECS) occupies a substantial volume fraction. Although most neurotransmitters and molecules transit through the ECS to ensure brain cell communication, understanding of molecular-scale ECS functional organization has remained limited. Near-infrared luminescent single-walled carbon nanotube (SWCNT) were previously propelled as unparalleled probes for ensemble imaging in whole animal owing to their brightness, photostability and spectral imaging range. Here, we combined near-infrared SWCNT tracking with super-resolution imaging approaches to unveil direct quantitative details of ECS live brain tissue.

Upon nanotube injection in live animal brains, long-term single-nanotube tracking was achieved in acute brain slices. Atypical SWCNT diffusion properties, imposed by their 1D geometry, were observed and used to establish nanoscale ECS dimensions and reveal the inhomogeneity of local viscosities in naive ECS of brain tissue (1). Modeling nanotube diffusion in complex environments further allows to extricate confinement and viscosity effects (2).

Finally, chemical alterations of the extracellular matrix strongly impact these parameters, supporting the view that the brain ECS is a heterogeneous and regulated compartment to fine-tune molecular communication between brain cells.



A) ECS dimensions revealed by single nanotube tracking in live brains, B) analysis of domain sizes of the ECS C) Super-resolved image of the ECS.

References

[1] A. Godin et al. *Nat. Nanotechnol.* (2016), advanced online publication.

[1] N. Danné et al. *in preparation*.

corresponding author: laurent.cognet@u-bordeaux.fr