Laurent COGNET
Title & employer: DR CNRS
Laboratory Name: LP2N – Institut d'Optique Graduate School, CNRS, Univ. Bordeaux
Laboratory Address: Institut d'Optique d'Aquitaine, 1 rue F. Mitterrand, 33400 Bordeaux-Talence
Website: www.cognet-research.com

CV/ biography

Laurent COGNET is CNRS Research Director at Institute of Optics in Bordeaux where he leads a group in nano&biophotonics. After a PhD in atom optics with A. Aspect (Orsay) and a postdoc in biophysics with Th. Schmidt's (Leiden University, NL), he was tenured as CNRS junior researcher in Bordeaux in 2000 to develop the emerging field of single-molecule detection and super-resolution microscopy in the context of biological applications. In 2006-7, he was a Fulbright scholar at Rice University (Houston, TX) and initiated original studies on carbon nanotube optics. He was promoted Research Director in 2009 and actively participated in 2011 to the creation of LP2N at Institute of Optics in Bordeaux. His current research interests include the nanoscale investigation of the biological matter based on innovative nanostructures and high-resolution optical microscopy. He has published over 90 papers totalizing more than 7000 citations and received several prizes of his achievements.

NANOSCALE EXPLORATION OF LIVE BRAIN TISSUE BASED ON SUPER-RESOLUTION MICROSCOPY AND NEAR-INFRARED EMITTING CARBON NANOTUBES

Single-molecule localization microscopy (SMLM) is a key approach used nowadays to study structural and dynamic arrangements of the matter at the nanoscale in a wide range of applications. As a member of the "super-resolution microscopy" family SMLM indeed provides optical images with resolutions well beyond the diffraction limit. Yet, it remains challenging to study more complex systems than isolated nanostructures or isolated living cells in biology with such approaches. For instance, SMLM in thick and intact brain tissues is penalized by the limited brightness of fluorescent emitters, the optical aberrations induced by the samples and/or the poor penetration of the light into biological tissue at visible wavelengths. To circumvent these limitations and investigate live brain tissues at the nanoscale, we developed a framework based on SMLM [1] and single-wall carbon nanotubes imaging [2] which luminesce in the near-infrared. Nanotube detection and tracking at the single nanotube level allow the extracellular space of intact live brain tissues to be revealed at the nanoscale and its modifications to be studied in the context of neurodegenerative diseases [3]. Building on this strategy, I will present how a toolbox of SMLM nanoprobes can be engineered in the near-infrared to study complex biological tissues through (i) the creation of photoswitchable carbon nanotubes [4] and (ii) ultrashort carbon nanotube displaying localized emission centers that could be revealed by super-resolution microscopy of the nanotube themselves [5]. Other applications in life and medical science beyond neurosciences will be presented.

[1] Heine et al *Science* (2008), Varela, et al *Nat. Com.* (2016)
[2] Cognet, et al *Science* (2007), Fakhri, et al *Science* (2010), Danné, et al *ACS Photonics* (2018)
[3] Godin, et al *Nat. Nanotechnol.* (2017), Soria et al *Nat. Commun* (2020)
[4] Godin, et al *Adv. Science* (2019)
[5] Danné et al, *ACS Nano,* (2018), Mandal et al, *Sci. Rep* (2020)
See also: www.cognet-research.com

Keywords: single molecule detection, carbon nanotube, nanoparticles, superresolution microscopy, neurosciences, near-infrared, tissue imaging, extracellular space