PHOTOSWITCHABLE SINGLE-WALLED CARBON NANOTUBES FOR SUPER-RESOLUTION MICROSCOPY IN THE NIR II WINDOW

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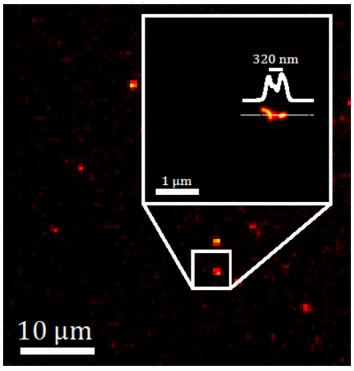
Single-molecule localization microscopy (SMLM) has set a new paradigm in the field of optical imaging by delivering super-resolution images i.e. with resolution much better than the diffraction limit. We demonstrated over the last years that such approaches can be designed to understand basic excitonic processes in carbon nanotubes [1-2]. In the field of bioimaging, SMLM is currently limited to the visible or far-red range, missing the near-infrared region where biological tissues are however the most transparent. One reason for this is that single-molecule emitter optical properties still need to be tailored in the near-infrared (in particular the NIR II region), including photoswitching capabilities which is a basic ingredient to achieve single-molecule SMLM. To fill this gap, optical imaging of single-wall carbon nanotubes can first be greatly facilitated in brain tissues by covalent functionalization of luminescent defects, reducing the required excitation light intensity by one order of magnitude [3]. In addition, we have introduced a novel type of hybrid nanomaterials consisting of single-wall carbon nanotubes covalently functionalized with photo-switching molecules that are used to control the intrinsic luminescence of the single nanotubes in the near-infrared (beyond 1 µm) [4]. Through the control of photoswitching, we demonstrate super-localization imaging of nanotubes unresolved by diffraction limited microscopy opening the route toward SMLM in the NIR II window for biological applications. Photocontrol of individual near-infrared emitters will also be highly desirable for elementary optical molecular switches or information storage elements since most communication data transfer protocols are established in this spectral range.



Diffraction limited and super-resolved image (insert) of carbon nanotubes fluorescing at 1064 nm [4].

[1] Cognet et al "Sub-diffraction Far-field Imaging of Luminescent Single-Walled Carbon Nanotubes" *Nanoletters*, **8** (2008) 749 - 753.
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[4] Godin et al "Photoswitchable single-walled carbon nanotubes for super-resolution microscopy in the near-infrared ", *Science Advances*, **5**, (2019) eaax1166