



Contribution ID: 910

Type: Poster

UV emission from lanthanide-doped upconversion nanoparticles in super-resolution microscopy: potential for cellular damage

Thursday 15 December 2022 18:45 (15 minutes)

“The upconversion nanoparticles (UCNPs) have recently attracted great attention as a fluorescence probe for use in super-resolution microscopy (SRM). This is due to the advantages of UCNPs over other fluorescence probes such as fluorescent proteins owing to their unique optical properties, lack of photobleaching and sharp emission peaks. However, the ultraviolet (UV) light that can be emitted from the UCNPs has been overlooked in most studies. The potential cell photodamage caused by UV light has been proven a limiting factor for in-vivo analysis. Here, UCNPs synthesised with eight commonly used combinations of Yb/Tm and Yb/Tm/Gd doped UCNPs were excited by pulsed and continuous wave (CW) lasers to evaluate their UV emissions. The UV-A and UV-B ratios were measured relative to the blue light emission at 475 nm which is traditionally used for imaging during SRM. We demonstrate that most samples generated UV light and that the dopant concentration has a key role in generating UV emissions. In addition, the usage of a pulse or CW laser for a similar UCNP sample can lead to large variations in the amount of UV emission produced. The results from this study highlight the importance of upconversion dopant concentration design as well as undertaking fluorescent analysis on synthesised UCNPs before their use to prevent unwanted cell photodamage during in vivo images taken with SRM.”

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Session Classification: Poster session

Track Classification: COMMAD: COMMAD: Materials and device characterisations