Multifunctional quantum dots for nanotheranostics and tissue engineering

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Among nanomaterials, multispectral nanoparticles that cover the visible spectrum and beyond are highly desired for imaging and optoelectronics, including wavelength tuneable lasers, light emitting diodes, and solar energy converters. Carbon quantum dots (CQD), in particular, have the potential for full-color emission tunability due to their versatility in using a range of precursors, chemical conjugation capacity, surface modifiability and atomic doping ability via facile synthetic protocols.

Cancer diagnostics in *in vivo* deep tissue setting is a challenging goal, however, multispectral and especially two-photon NIR-active emissivity can provide viable means to accomplish the task. In this context, metal based QDs and conventional dyes suffer from cytotoxicity and photo instability whereas CQDs can be rendered biocompatible and can offer ease of surface conjugation with tunable optical characteristics. Thus, the presence of active moieties on CD surfaces allow multimodal conjugation, making them suitable for a range of applications.

These non-invasive and non-toxic quantum dots are being developed for critical applications in cancer diagnosis and therapeutics through targeted drug delivery. In addition, the use of these quantum dots with scaffolds provide mechanical stability and efficient methods to monitor the state of the scaffolds and cells in tissue engineering. The design, synthesis, characterisation and evaluation of these novel quantum dots for disease diagnosis, therapeutic delivery and tissue engineering will be presented.