Nanoscale Biophotonics - using light to measure the previously unmeasurable within the central nervous system

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Biophotonics is the science of generating light and harnessing the photons to image and manipulate biological systems, and to resolve precisely targeted signals in living tissues. The Centre of Excellence for Nanoscale BioPhotonics (CNBP), funded by a partnership of the ARC, state governments, academic institutions and industry, is focused on developing novel light-based sensing technologies that serve as windows into the body to "see" biological cellular processes which have previously been undetectable.

Novel sensing modalities are being developed based on biophotonics sensors, built with microstructure fibre optics that surpass the traditional single and multimodal optic fibres. Current work is using sensing fibres as miniature microscopes that allow monitoring in spatially restricted anatomical locations that are otherwise inaccessible. Instead of taking cells to microscopes, biophotonics is taking miniature microscopes to cells. These and other fibre sensing capabilities are being developed in CNBP as a high-tech multi-institutional collaborative partnership of research expertise in physics, chemistry, biology, materials science and engineering. Nanoparticles are being used to measure and quantify molecular processes in cells in tissue and in the living body. Pushing beyond existing limits, sensing ultrasound is being refined by using smaller receivers, in the form of metal nanoparticles, to allow imaging of tiny blood vessels. Rare-earth doped nanocrystals are proving valuable as a novel luminescent probes, and have been successfully employed in sensitive immunodetection of prostate cancer cells. Combined with a gated auto-synchronous luminescence detector (GALD), cellular autofluorescence can be suppressed to allow the capture of vivid images of immune-stained cancer cells.

Light based sensing technologies are revolutionising our ability to quantify what was previously unmeasurable, and are being translated into clinical practice. Seeing small to understand the big picture is successfully crossing from bench to bedside.