Photonics as a Tools for Biomedical Applications

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A significant advance in the development of reliable near-infrared lasers has provided researchers with great opportunities to create compact photonic systems and innovative approaches for disease diagnostics and treatment.

Photodynamic therapy (PDT), which has been used for a long time to treat cancers, employs photosensitisers (PS) to convert light energy (440–650 nm) into the photochemical generation of reactive oxygen species (ROS), including singlet oxygen ($^1O_2$). We have demonstrated the direct excitation of molecular oxygen (O_2) into $^1O_2$ using 1267 nm laser irradiation.

Here, we present the results of our extensive research into photosensitiser-free oxidative stress generation using lasers emitting around the 1267 nm wavelength in both non-cancerous and cancerous cells, as well as in rat glioblastoma models. This research has revealed the effects of such laser irradiation on different cell types and tumours, as well as its mechanism of singlet oxygen generation – a critical starting point in inducing apoptotic reaction chains that lead to the selective death of cancer cells *in vivo*. Glioblastoma is the most lethal form of brain cancer, characterised by very limited treatment options and poor prognosis. In this presentation, we demonstrate that glioblastoma growth can be effectively suppressed through photosensitiser-free laser treatment using a quantum-dot-based 1267 nm laser diode. Our study showed that a four-week course of 1267 nm laser irradiation significantly suppresses glioblastoma growth and increases the survival rate from 34 to 64%. This technique represents a promising breakthrough in non-invasive or minimally invasive therapy for superficial glioblastoma.

We will also present our recent findings on the destruction of melanoma cells in a 3D human skin model with melanoma using 1267 nm light irradiation.