Direct photosensitizer-free laser treatment of cancers

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Recent advances in near-infrared laser technology have opened new avenues for the development of compact photonic platforms and novel approaches to disease diagnostics and therapy. Photodynamic therapy (PDT), a long-standing method for cancer treatment, typically relies on photosensitisers (PS) to convert visible light (440–650 nm) into reactive oxygen species (ROS), including singlet oxygen ($^1O_2$). In our work, we demonstrate a fundamentally different approach: the direct excitation of molecular oxygen into $^1O_2$ using 1267 nm laser irradiation, without the need for photosensitisers.

We present extensive experimental data on photosensitiser-free ROS generation using 1267 nm laser light in both normal and cancerous cells, as well as in animal models of glioblastoma. Our findings reveal selective oxidative effects and apoptosis induction in cancer cells, driven by $^1O_2$ production. Notably, in a rat glioblastoma model, a four-week treatment with a quantum-dot-based 1267 nm laser diode significantly inhibited tumor growth and increased survival rates from 34% to 64%.

Additionally, we report new results demonstrating the effective destruction of melanoma cells in a 3D human skin model using the same laser wavelength. These findings position 1267 nm photosensitiser-free laser therapy as a promising, non-invasive or minimally invasive treatment strategy for superficial cancers, particularly glioblastoma and melanoma.

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