Project Title:

Light-emitting hydrogel microimplants for wireless cancer phototherapy

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Project Abstract/Proposal Summary:

Photodynamic therapy (PDT) is a treatment based on the selective destruction of tissue through a combination of light, light-sensitive drugs (photosensitizers), and molecular oxygen. Although each component is individually harmless, optical irradiation of the photosensitizer at a specific wavelength results in cell death due to photosensitizer-mediated generation of cytotoxic reactive oxygen species such as singlet oxygen. PDT is a potential cancer treatment modality that has several key advantages over other treatment options, for example, the localized nature of the treatment (no systemic effect as in chemotherapy), minimal or manageable side effects, ease of use, repeatability (unlike dose-limited radiation therapy), and the ability to trigger the body's anti-tumour immune response. PDT has been proven clinically effective in early lung cancer, Barrett's esophagus, bladder cancer, head and neck cancers, and is the primary treatment for skin cancer. Critically, in cases of highly infiltrative cancers such as liver cancer, breast & bile duct cancers, where complete resection is sometimes impractical because of proximity to vital structures, making recurrence inevitable, PDT can potentially serve as primary or adjuvant therapy. However, clinical use of PDT is severely constrained by the low penetration depth of visible light through thick tissue, limiting its use to target regions only a few millimeters deep, and this is a common problem for all phototherapy methods. Currently, fibre optics are usually used for PDT and inserted into the human body through natural channels, however, it requires extensive and bulky light devices and the patient's movement is completely restricted. It is highly invasive and such an invasive procedure limits its recurrence usage. In this project, we will bring PDT to a new level by developing a self-powered device for wireless phototherapy in deep tissues.