Project Title: Transforming Brain Tumor Surgery Through Coherent Raman Microscopy

Abstract: The central objective in brain tumor surgery is to maximize removal of tumor, while sparing adjacent healthy tissue. Despite clear differences on a histologic level, cancerous tissue is often indistinguishable from healthy tissue in the operating room. Consequently, tumor that would be safe to remove is left behind. The presence of residual tumor may result in premature recurrence, treatment failure and poor outcome. In addition, normal tissues, mistaken as tumor, may be removed, resulting in unnecessary neurologic deficits. Currently, there is no widely accepted method for delineating tumor from normal brain during surgery. Stimulated Raman scattering (SRS) microscopy, a cutting-edge imaging method, has the potential to enable surgeons to reliably differentiate cancer-infiltrated tissue from healthy tissue during surgery. SRS microscopy enables rapid, high-resolution, label-free, cellular-level imaging of biological tissues based on the intrinsic spectroscopic properties of their macromolecular components such as lipids, proteins and DNA. SRS microscopy is uniquely well suited for intra-operative imaging because it can be performed in situ based on back-scattering of the excitation signal.
We have recently demonstrated that cancerous tissue can indeed be detected and differentiated from normal brain, on a cellular level, in primary human glioblastoma xenograft animal models in vivo using an SRS microscope. This proposal, designed to carry out the first SRS imaging of human brain tumor specimens, will lay the foundation for the integration of SRS as an intraoperative imaging technique capable of improving the accuracy of brain tumor surgery.