New Applications of Oxygen Imaging by Phosphorescence Quenching and Luminescent Dual-Mode Temperature/Oxygen Probes

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The ability to quantify oxygen \textit{in vivo} in 3D with high spatial and temporal resolution is valuable for many areas of biological research. Our laboratory has been developing the \textit{phosphorescence quenching} technique for biological oximetry. In the past we designed dendritic porphyrin-based oxygen probes for oxygen imaging in tissues and more recently expanded our design on special probes for two-photon phosphorescence lifetime microscopy (2PLM) of oxygen. We will briefly discuss new emerging applications of phosphorescence quenching, including quantification of oxygen gradients between intestinal tissue and gut lumen, two-color phosphorescence oximetry in the brain, deep tissue oximetry by Cerenkov-Excited Luminescence Scanned Imaging (CELSI) as well as new applications of 2PLM. We will also present dual-mode temperature/oxygen sensors, which emit luminescence on the microsecond time scale from two excited electronic states existing in thermal equilibrium. While the decay rates are subject to various quenching processes (e.g. by oxygen), the ratio of the integrated intensities is affected only by temperature. Importantly, the new probes have high multiphoton absorption cross-sections, and thus allow for simultaneous depth-resolved two-photon imaging of both oxygenation and temperature in living tissues.