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Absorption and photoreceptor properties of dissolved oxygen molecules under natural conditions. Review of currently available results

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It is known that molecular oxygen has the triplet ground state and two relatively low-lying singlet states, whose zero and higher vibrational sublevels can be populated upon oxygen excitation. However, triplet-singlet transitions in oxygen molecules are highly forbidden. Therefore, corresponding absorption bands are extremely weak. As a result, until recent time, nothing was known about the absorption properties of oxygen dissolved in natural systems under ambient conditions. Apparently, this information is of basic importance for oxygen photonics and understanding the state and function of oxygen molecules in chemical and biological systems. Interest to this problem is also stimulated by the suggestion that oxygen molecules might serve as photoreceptors causing biological and therapeutic action of laser and LED radiation. A decade ago our group started a project, which allowed us to strongly approach the solution of the above problems. We have shown that formation of singlet oxygen can be reliably detected upon direct laser excitation of oxygen in air-saturated solutions using oxygenation of singlet oxygen traps [1]. From kinetic analysis of oxygenation rates accurate absorption coefficients were obtained for oxygen absorption maxima at 765, 1070 and 1270 nm in several common organic solvents and water. Recently, we extended our photochemical studies to oxygen excitation in red and dark red regions and compared the results with those obtained from detection of singlet oxygen phosphorescence upon direct oxygen excitation by laser radiation (see refs. in paper [9]). The present paper is aimed to summarize and discuss all currently available results of our group. Major experimental papers of our group are indicated in the reference list.

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