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The effect by the light quenching of the delay fluorescence of dye molecules in tissues

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There is important a problem of oxygen concentration control in living tissue during photodynamic therapy. One of the most promising methods of the oxygen quantity evaluation in tissue is a using of delayed fluorescence (DF) conditioned by annihilation of singlet oxygen and triplet-exited sensitizer molecules [1, 2]. In present work, the dependence between the tissue oxygen quantity and sensitizer DF intensity is discussed.

Kinetics of DF and phosphorescence of organic dyes in healthy tissues and breast cancer of the BYRB line mice in vitro were investigated. Shown defining the role of oxygen in the process of deactivation the triplet states of dye molecules in the cells. The effect by the light quenching of the delay fluorescence (LQDF) of dye molecules at repetitively pulsed excitation in biological tissues was detected. It is found statistically significant difference in the nature delayed fluorescence and volume LQDF of dye molecules in the tissues of healthy and sick mice.

The effect of LQDF during the periodic pulse excitation may be caused by two reasons: 1) rapid singlet oxygen consumption in tissue via oxidation reactions after each excitation pulse; 2) relatively slow recovery of the initial oxygen concentration in the interval between the pulses.

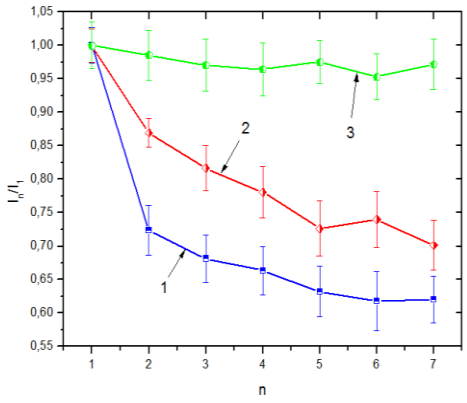

Fig. 1

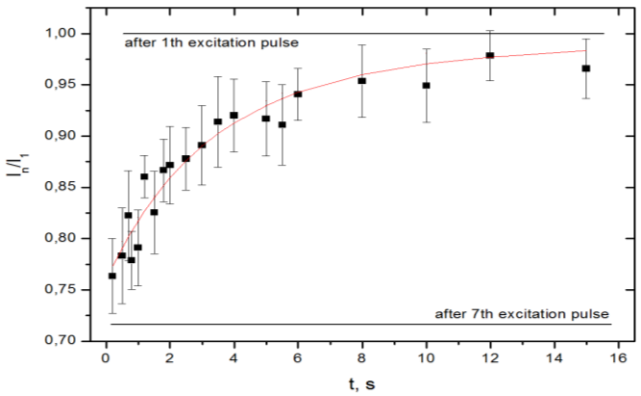

Fig. 2

Integral intensity of early (first 10 microseconds) parts of DF kinetics curves inducted by laser excitation pulses following consecutive with a period of 0.1 (1) and 0.2 (2) seconds in tumor and 0.2 seconds (3) in healthy breast tissues normalized to first curve intensity shown at Fig.1

Restoring intensity of delayed fluorescence of erythrosine in tumor after excitation by 7 serial laser pulses with a period of 0.2 seconds at the Fig.2 illustrated.

The effect of the light quenching of the delayed fluorescence for the definition of "dose" of radiation in photodynamic therapy directly into the session can also be used.

1. S.N. Letuta, S.N. Pashkevich, A.T. Ishemgulov, Yu.D. Lantukh, E.K. Alidzhanov, S.S. Sokabaeva, V.V. Bryukhanov // Photochem. & Photobiol. 163 (2016) 232—236.

2. S.N. Letuta, A.F. Kuvandykova, S.N. Pashkevich, A.M. Saletsky, Rus. Phys. Chem. A. 87 (2013) 1582–1587.