

PROBING TUMORS WITH FIBER BASED FLUORESCENCE AND PHOSPHORESCENCE LIFETIME SPECTROSCOPY

Maria Lukina^{a)}, Anna Orlova^{a)}, Marina Shirmanova^{a)}, Antje Neubauer^{b)} Wolfgang Becker^{b)}, Elena Zagaynova^{a)}, and Vladislav Shcheslavskiy^{b)}

¹*Nizhny Novgorod State Medical Academy, Minin and Pozharsky Square, 10/1, Nizhny Novgorod, Russia 603005*

²*Becker&Hickl GmbH, Nahmitzer Damm 30, Berlin 12277, Germany*

E-mail: vis@becker-hickl.de

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The study of metabolic and oxygen states of cells in a tumor *in vivo* is crucial for understanding of the mechanisms responsible for the tumor development and provides background for the relevant tumor's treatment. In this report, we show that a specially designed implantable fiber-optical probe provides a promising tool for optical interrogation of metabolic and oxygen states of a tumor *in vivo*. In our experiments, the excitation light from a ps diode laser source is delivered to the sample through an exchangeable tip via a single mode fiber, and the emission light is transferred to the detector by another multimode fiber (Fig. 1). Fluorescence lifetime of nicotinamid adenine dinucleotide (NAD(P)H) and phosphorescence lifetime of an oxygen sensor based on iridium (III) complex of enzothienylpyridine (BTPDM1) are explored both in model experiment in solutions, and in living mice. An increase in the contribution of the short lifetime component (free NAD(P)H) in the fluorescence decay indicates a shift to more glycolytic metabolism in tumor tissue as compared to muscle. On the other side, the lifetime of BTPDM1 phosphorescence from tumor regions was longer than that from extra-tumor regions, thereby demonstrating tumor hypoxia. To the best of our knowledge, the measurements of both metabolic status and oxygenation of tumor *in vivo* by fluorescence/phosphorescence lifetime imaging (FLIM/PLIM) with a fiber-optic probe are done for the first time.

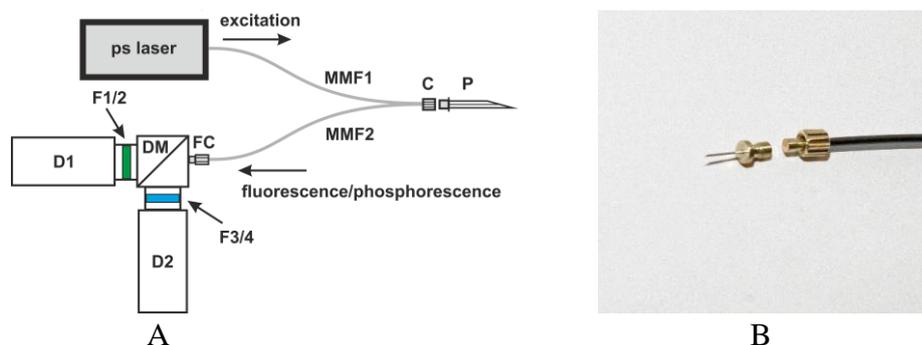


Figure 1. (A) Experimental setup for fluorescence/phosphorescence spectroscopy measurements. MMF1: Multimode fiber (core diameter: 50 μm , cladding diameter: 65 μm); MMF2: Multimode fiber (core diameter: 200 μm , cladding diameter: 220 μm); C: miniature connector; P: exchangeable probe with a multimode fiber (core diameter: 300 μm , cladding diameter: 350 μm) in a needle G26); FC-FC connector; D1 and D2: HPM-100-40 detector. F1/2: emission filters 510LP and 632/90 BP. F3/4: 405LP and 450/60BP. DM: 510 LP dichroic mirror. (B) Image of exchangeable probe (P) and miniature connector (C).