Photophysical properties of Radachlorin photosensitizer in solutions and cells obtained using FLIM and digital holography

I.V. Semenova, A.V. Belashov, A.A. Zhikhoreva, O.S. Vasyutinskii
Ioffe Institute, 26, Polytekhnicheskaya, 194021 St. Petersburg, Russia

In this report we present experimental evaluation and analysis of photophysical properties of Radachlorin photosensitizer (PS) in bulk solutions, in aqueous solutions sprayed onto different biological surfaces and in living cells. The research aimed at revealing photophysical basics for the processes associated with photodynamic inactivation of viral and bacterial infections and photodynamic therapy of malignancies. Experiments were performed using time-resolved analysis of PS fluorescence and singlet oxygen phosphorescence, FLIM and digital holography. Radachlorin fluorescence lifetimes and corresponding singlet oxygen quantum yields were analyzed in bulk solutions as a function of pH and PS concentration. The kinetics of PS photobleaching sprayed on biological surfaces were studied at normoxic and hyperoxic conditions and were shown to change significantly depending upon the surface, with characteristic decay times varying from seconds to minutes. The response of living cells to photodynamic treatment with Radachlorin was analyzed in three established cell lines of different origin (HeLa, A549 and 3T3) using holographic and fluorescence microscopy. The analysis was performed on different aspects of the treatment procedure including PS accumulation, localization and photobleaching in cells and post-treatment dynamics of changes in cellular morphology at different treatment doses. The comparison of the results obtained showed that lower resistance of HeLa cells to treatment correlated with higher PS accumulation and higher bleaching rate while higher resistance of 3T3 cells correlated with lower accumulation and longer photobleaching. The financial support from RSF under the grant # 21-72-10044 is gratefully acknowledged.