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Uptake of chlorin e_6 photosensitizer by polystyrene-diphenyloxazole-PNIPAM hybrid nanosystem studied by electronic excitation energy transfer

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Radiodynamic therapy (RDT) approach to cancer treatment is intensively studied in the last years; one of the research scopes is the development of sensitizers that generate singlet oxygen upon X-ray excitation. Earlier, in the frames of designing nanosystems (NS) for X-ray excited sensitizing of singlet oxygen, we studied electronic excitation energy transfer (EEET) in polystyrene (PS)-diphenyloxazole (PPO)-chlorin e_6 NS [1]. Here, PS-PPO nanoparticles with attached cross-linked poly-N-isopropylacrylamide (PNIPAM) chains were obtained resulting in hybrid PS-PPO-PNIPAM NS. PNIPAM has conformation transition in physiological temperature range; so the mentioned hybrid NS could be a basis for temperature-sensitive RDT sensitizing formulation.

PS-PPO-PNIPAM hybrid NS were prepared by miniemulsion polymerization of styrene, PPO and N-isopropylacrylamide in water media with a procedure similar to that described in [2]. To the solution of obtained NS in 50 mM TRIS-HCl buffer (pH 7.2), the photosensitizer chlorin e_6 was added. Fluorescence spectra of chlorin e_6 added to PS-PPO-PNIPAM hybrid NS revealed EEET from PS matrix and encapsulated PPO to chlorin e_6. EEET efficiency increased almost twice during one hour after chlorin e_6 addition, indicating that uptake of chlorin e_6 by PNIPAM part of hybrid NS still proceeds during this time. Heating of PS-PPO-PNIPAM-chlorin e_6 NS from 21 ^{0}C to 39 ^{0}C results in an enhancement of EEET efficiency; this is consistent with PNIPAM conformation transition that reduces the distance between PS-PPO donors and chlorin e_6 acceptors. Meanwhile, relatively small part of chlorin e_6 present in the solution is bound by PNIPAM; thus further studies in this direction are necessary.

1. *Losytskyy M. Yu., Vretik L. O., Nikolaeva O. A., Marynin A. I. , Gamaleya N. F., Yashchuk V. M.* Polystyrene-diphenyloxazole-chlorin e_6 nanosystem for PDT: energy transfer study // Mol Cryst Liq Cryst.-2016.-**639**.-P. 169-176.
2. *Ballauff M., Lu Y.* ''Smart'' nanoparticles: Preparation, characterization and applications // Polymer .-2007.- **48**.-P. 1815-1823.