Investigation of the Kinetics of Photoinduced Electronic Transitions in Nanostructures of Bacterial Reaction Centers

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The high reactions efficiency of photo-stimulated electron transfer (ET) in biological systems, including the structure of reaction centers attracted attention of many researchers. Analysis of the main factors determining the speed of such reactions is important both in fundamental terms, and in terms of creating artificial systems, storage and energy conversion. Found that ET in biological systems occurs as series of ET in the structure of proteins between the metal centers or organic donor-acceptor groups at a distance of 5-25 Å. In this regard, series of experiments related to ET in the structure of proteins was conducted.

We have researched the kinetics of electron transport in bacterial reaction centers (RC). We have researched the processes of relaxation and photoinduced structural changes in molecular complexes RC Rhodobacter spharoides in the process of intramolecular electron transfer. We have presented results of experimental research of depending transition microspeed between donor and acceptor on the RC illumination intensity and time and on theoretical analysis of relaxation curves by using wavelet transforms.

Following conclusions were done from the research:

1. Kinetics microspeed of the electron transfer from the donor to the acceptor and donor acceptor solutions at RC Rhodobacter sphaeroides, depends on illumination time and intensity. With increasing time or intensity reduction processes are slower, which may indicate the influence of polarization effects on the processes of intramolecular electron transport.

2. The received dependences of optical absorption and quantitative parameters of the kinetics of the oxidation reaction centers at different modes of photo excitation allowed to divide the kinetics of optical absorption to two parts: slow and fast. Fast kinetics characterizes electron transport and slow one - electron transport and slow conformational change RCs.

3. Wavelet analysis examines features of experimental curves of relaxations, depending on the intensity and exposure time. It shows that the restoration and acquisition solutions RC is non-stationary process in time. We make the assumption, that the exponent in the relaxation curves do not act simultaneously and are included in sequence.

4. With the exclusion of light exiting the optical absorption of the solution returned in original condition, which proves that the photo induced changes in the molecular complex RC are reversible. Measurement of the refractive index of the solution by holographic interferometry shows that the change in volume of the molecular complex RC, with its light, is 0.1% -1%. This change in

volume of the RC can be caused by a change in the angle between the bonds M, L, H RC globules that are most labile.

5. Qualitative coincidence of oxidation kinetics of recovery with phytospectrums RC in their light, confirming the relationship between electron transport and conformational changes in RC.

Thus high efficiency reaction photo-stimulated electron transfer in biological systems, including the structure of the reaction centers enables to understand and learn to use photo processes. Analysis of the main factors that determine the rate of such reactions is important as a fundamental and from the point of view of creating artificial systems of conservation and transformation of energy, enabling the improvement and creation of new medical nanoelectronics.

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