HOW DO TiO_2 NANOPARTICLES CHANGE THE FUNCTIONALITY OF PHOTOSYSTEM II DURING THE LIGHT PHASE OF PHOTOSYNTHETIC PROCESS?

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Electromagnetic radiation from the Sun falling on the Earth surface is efficiently utilized by plants, algae and cyanobacteria during photosynthesis. This process became an inspiration for scientists to search for new methods of collecting and storing energy. Some mechanisms of the light phase of photosynthesis could be a solution for the fuel-energy needs of human-kind. Especially, understanding of the functionality of photosystem II (PSII) is needed to fully make use of this opportunity.

The main goal of our research is an investigation of the early steps of the photosynthetic process with special attention to the functionality of PSII in higher plants (Spinacia oleracea) modified with the presence of titanium dioxide nanoparticles (TiO_2 NPs).

In our study, we used a Joliot type electrode [1, 2], thermoluminescence (TL) [3, 4], and Pulse-amplitude modulated (PAM) fluorometry [5]. TL and PAM measurements showed how TiO_2 NPs modulate linear electron transfer between Q_A and Q_B Plastoquinones on the acceptor side of PSII and change the 'open' Reaction Centres fraction. Using a fast polarographic method we found that O_2 evolution had biphasic character and the time constants of the two channels of oxygen yield differed by an order of magnitude in isolated photosynthetic membranes enriched in PSII (BBY PSII). Our further studies showed that TiO_2 nanoparticles may interact with the donor side of PSII and trigger oscillatory changes of its characteristic parameters.

Obtained results allowed us to suggest a possible molecular mechanism of TiO_2 nanoparticles action on both donor and acceptor sides of PSII reaction centres. This creates a possible application of PSII-TiO_2 NPs hybrid systems in constructing environmentally friendly solar and fuel cells.

Keywords: photosynthesis, photosystem II, TiO_2 nanoparticles.

References

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