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Plant Nanobionics: possible biotechnological solutions for biofuels and bioenergy production

The development of various biohybrid natural or artificial systems for promoting the solar energy conversion is of high priority in contemporary energy research. Plant nanobionics merges plant biotechnology and nanotechnology taking advantage of the fusion of highly dynamic and adaptive cell structures with easily manipulated inorganic material at nanoscale level. This new emerging technology promises not only to improve plant photosynthetic features but also to impart plants with new and enhanced functions. Here we have evaluated the potential of single-walled carbon nanotubes (CNTs) to enhance the photosynthetic performance of algae and thus to open new opportunities for more efficient use of the photosynthesis-based systems in the sustainable production of energy, biomass and high-value compounds was evaluated. Our studies of the effects of CNTs on the photochemical reactions in the unicellular green algae Chlamydomonas reinhardtii pointed out the ability of the nanotubes to modify the growth and photosynthesis of algal cells. Particularly, the characterisation of CNT interaction with photochemical events of photosystem II (PSII) and photosystem I via chlorophyll fluorescence spectroscopy indicated CNT-induced alterations in the PSII electron transport and non-radiative loss of excitation energy in both photosystems. With the scope to gain further insights into the electro-optical interactions of CNTs with light-dependent photosynthetic reactions we used isolated photosynthetic complex (PSCs) with different level of complexity, such as thylakoid membranes, PSII-enriched membrane fragments and light-harvesting complexes of PSII. The energy and electron fluxes in the biohybrid (PSCs/CNTs) systems were analysed by steady-state chlorophyll fluorescence and time-resolved fluorescence spectroscopy. The possible processes involved in the energy excitation decay in the photosynthetic structures in the studded model systems will be discussed.

Keywords: carbon nanotubes, photosynthesis, microalgae, photosynthetic complexes

Biography:

Maya Dimova Lambreva, permanent position as a Researcher at the Institute of Biological Systems, National Research Council of Italy. Dr. Lambreva has a PhD in Plant Physiology from Bulgarian Academy of Sciences. Since 2007 she has been working at the National Research Council of Italy. Her work is focused on the biophysical and biochemical aspects of the light photosynthetic reactions in microalgae and plants with the goal of developing bio-based applications employing photosynthetic organisms or photosynthetic elements. Dr. Lambreva has extensive expertise in different methods of chlorophyll fluorescence spectroscopy and in the quantification of photosynthetic activity. Currently, she is interested in using carbon-based nanomaterials for promoting the solar energy conversion in biohybrid systems based on photosynthetic specimens.