On the interaction of carbon nanotubes and microalgae

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A critical mass of knowledge is emerging on the interactions between plant cells and engineered nanomaterials, revealing the potential of plant nanobiotechnology to promote and support novel solutions for the development of a competitive bioeconomy. Application of carbon nanotubes (CNTs) in plant biotechnology and agriculture brought to light an increasing amount of new findings, revealing the potential of CNTs to promote plant growth and crop production, or to control the delivery of fertilizers or pesticides to crops [1,2]. Furthermore, the combination of highly dynamic and adaptive plant cell structures with easily manipulated inorganic material at nanoscale level paved the way for a new emerging technology, the so called plant nanobionics, which promised not only to improve plant photosynthetic features but also to impart plants with new and enhanced functions [3,4]. The plant nanobionics approach suggested the capability of CNTs to increase the efficiency of solar energy harnessing in the photosynthetic process and improve cell response to oxidative stress conditions [3]. This new knowledge may foster the exploitation of the nanotechnology tools to empower photosynthetic performance and production yields of commercially important microalgal species.

Large-scale cultivation of microalgae in photo-bioreactors plays an important role in the production of biomass, biofuels or high-value compounds [5]. One of the main problems in high-density-cultured algal bioreactors is the reduction of production yield due to occurrence of strong light-shading. Besides, very often, the introduction of different stress conditions (e.g. nutrients starvation) is exploited to redirect the algal metabolism towards the synthesis of desired compounds. Thus, experimental strategies taking advantages of SWCNT ability to assist the photosynthetic electron transport and the cell uptake of engineered nanoparticles or molecules with antioxidant or signaling functions bare great capacity to improve fitness and photosynthetic performance of commercially important photosynthetic microorganisms under large-scale manufacture conditions [6]. Here we will discuss the potential of the CNTs to enhance functions of algae facilitating a more efficient use of photosynthetic algal systems in the sustainable production of valuable goods. The research is focused on the development of experimental approaches to enable the interactions of photosynthetic microorganisms and CNTs, and to study the effects of CNT properties on algal fitness and photosynthetic performance, and nanotubes uptake into algal cell.

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