Interaction of single-walled carbon nanotubes (SWCNTs) with photosynthetic systems

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For years, the distinctive optical and structural properties of single-walled carbon nanotubes (SWCNTs) have inspired the development of promising applications in the field of cell nanobiotechnology[1], [2]. In particular, the synergistic interaction with photosynthetic organisms has attracted an increasing level of attention due to the potential of engineered nanoparticles to enhance the native performance of biological systems, paving the way for novel, renewable, and low cost solutions for light-harvesting, energy conversion and subcellular sensing[3], [4].

So far, major studies have largely focused on enabling cellular uptake of SWCNTs by engineering the SWCNT surface through non-covalent side-wall functionalizations. Non-covalent functionalization with a rich variety of biomolecules and polymers has been shown to potentially increase SWCNT solubility and membrane translocation while endowing these nanostructures with enhanced biocompatibility[5].

Most recently, this platform has been successfully applied to intact chloroplasts to augment their photosynthetic capability and improve stability against reactive oxygen species[6]. Our work builds on these empirical findings to gain an in-depth understanding of the dynamics of the underlying interaction on a molecular level. We performed a systematic investigation of the effect of SWCNT functionalization on membrane penetration properties using a novel biological host. The results of this study offer great promise for the development of a new generation of light-harvesting nanobionic devices.

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