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Light dependent redox catalysis by Photosystem I complexes encapsulated in organic nanoparticles

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Photosystem I (PSI) is a pigment binding multi-subunit protein complexes involved in photosynthesis. PSI is localized in the thylakoid membranes and catalyze the electron transfer reaction from plastocyanin to ferredoxin, as one of the main steps involved in conversion of light energy into chemical energy. PSI is highly efficiency with a photochemical efficiency close to one. Several attempts have doing in the past in order to exploit the high efficiency and high stability of PSI in an extra-cellular context in order to catalyze electron transfer reactions: in this work we present an innovative solution for exploiting the photochemical properties of PSI, by encapsulation of PSI complexes in organic nanoparticles. Nanoparticles offer a protected environment to the encapsulated molecule, giving it the possibility of preserving its functional properties and studying how they change over time. In this work the complete characterization, both morphological and functional, of nanostructures obtained by encapsulation of PSI complexes purified from higher plants with PLGA (poly lactic-co-glycolic acid) polymer is presented. The results obtained by transient absorption and time-resolved fluorescence demonstrate that encapsulated PSI were characterized by an higher photochemical activity compared to PSI complexes in detergent solution. Moreover, encapsulated PSI maintained the high efficiency observed for several weeks even if exposed to very strong light, being more stable compared to PSI in detergent solution. Finally, the nanostructures obtained by encapsulated PSI were able to catalyze light dependent redox reactions with electron acceptors and donors outside the nanostructures Potential application of these PLGA encapsulated PSI in different fields are thus presented and discussed.