In-situ monitoring of the regulation of photosynthesis in microalgae using in-cell real-time NMR.

Keywords

in-cell NMR, photosynthesis regulation, redox transition, Calvin Benson Basham cycle, structural NMR, diffusion ordered NMR spectroscopy.

Summary

The assimilation of CO_2 by photosynthetic organisms thanks to the Calvin-Benson-Bassham (CBB) cycle is a key process of the carbon cycle in the biosphere and a prerequisite for the synthesis of biomolecules by these organisms. New lessons emerge from this ancient process and recent genetic studies that are re-assessing the classic redox regulation[1]. The applicant will monitor in-situ and in real-time the relative population of the reduced and oxidised states of known redox mediators including NADP/NADPH or GSSG/GSH on model micro-algae upon light-to-dark and dark-to-light transitions using NMR. Also, the redox transition of a well-known regulatory protein, CP12, will be investigated directly in the chloroplast. Different means will be employed to introduce NMR visible ^{15}N-labelled CP12 in NMR invisible chloroplast[5]. Besides, the effect of molecular crowding will be monitored using diffusion-ordered NMR spectroscopy[6]. Despite the recent development and renewed interest for in-cell structural biology[7] and real-time in-cell metabolomic[8], this approach has not yet been applied to photosynthetic cells using NMR.

The success of this approach will rely on the close collaboration between a group specialised in biochemistry: micro-algae culture, protein production and purification, enzymatic regulation[9,10] (BIP2), and a group specialised in NMR methods development for the identification and characterisation of biomolecules in complex solution (BioSciences)[11,12]. The applicant will have an easy access to NMR spectrometers: 600MHz liquid, 600MHz with a cryo-probe, 400MHz HR-MAS, and to algal-culture and biochemistry laboratories.

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Expected profile of the candidate

The candidate should have a strong background in biochemistry and knowledge of NMR.