Biohybrid Antenna: Triple Your Chromophores, Triple Your Energy

Scientific Achievement

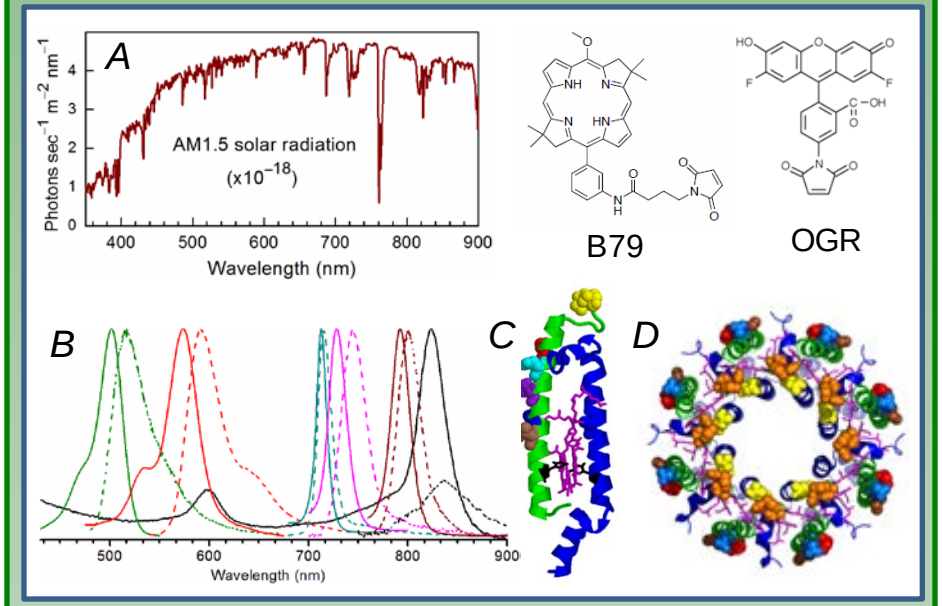
Prepared analogues of native photosynthetic polypeptides with two additional chromophores which, because of the polypeptides' binding affinity, self-assembled to form dimers that, in turn, oligomerized to form robust, nanoscale light-harvesting complexes with enhanced light capture.

Significance and Impact

Preparations demonstrate the advantage of using intelligent biohybrid scaffolding capable of organizing pigments, within the protein and in nanoscale circular arrays, which enhance light absorption and energy transfer to a selected target.

Research Details

- Extended previous studies* to construct biohybrid light-harvesting complexes containing bacteriochlorophyll and two additional types of chromophores.
- Demonstrated a relay effect to improve energy transfer from chromophores at distant sites to achieve both high efficiency and enhanced solar coverage.
- Doubled the density of chromophores within the complex.
- Demonstrated the versatility of biohybrid scaffolding for self-assembly of robust, nanoscale structures.



A. Solar energy reaching the earth's surface.
B. Chromophore absorption (solid) and emission (dashed) spectra: OGR (green), B79 (cyan), Bchl (black).
C. Dimeric structure (B820) with 6 positions used for modification of the β polypeptide (green) indicated by colored side chains. A double chromophore derivative was constructed with OGR and B79 attached to the amino acids with the yellow and purple side chains, respectively.
D. Top view of self-assembled light-harvesting complex.

*JW Springer, PS Parkes-Loach, KR Reddy, M Krayer, J Jiao, GM Lee, DM Niedzwiedzki, MA Harris, C Kirmaier, DF Bocian, JS Lindsey, D Holten and P Loach J. Am. Chem. Soc. 2012, 134, 4589-4599.

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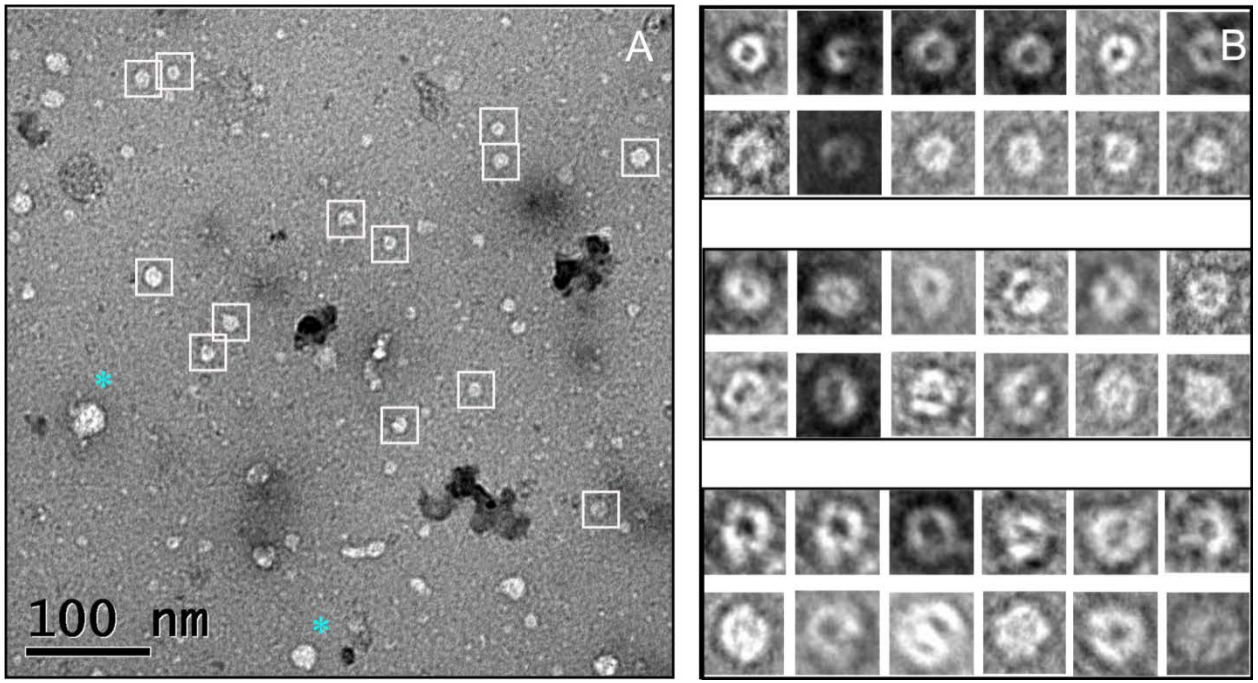
Biohybrid Antenna: Collaborators and New Data



PARC PI collaborators

Dave Bocian
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Jonathan Lindsey
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Paul Loach
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Negatively stained electron microscopy image of reconstituted light havesting complex 1 molecules (data of Pu Qian).

A) EM micrograph of the preparation of reconstituted LH1 complexes. The protein was stained using 0.75% (w/w) uranyl formate, and the image recorded at a nominal magnification of 285,000 x on a Philips CM 100 electron microscope fitted with 1K x 1K Gatan Multiscan 794 CCD camera. Typical LH1 particles are boxed in white and aggregated particles are indicated with blue asterisks.

B) Gallery of selected single particles of LH1 complexes. The box size is 235 x 235 Å. The different sizes of the LH1 particles are classified into sets of 12, with the top, middle and low galleries showing particles with approximate diameters of 118 Å, 141 Å and 165 Å respectively.