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A Nanophotonic Structure Containing Living Photosynthetic Bacteria

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Abstract

 Photosynthetic organisms rely on a series of self-assembled nanostructures with tuned electronic energy levels in order to transport energy from where it is collected by photon absorption, to reaction centers where the energy is used to drive chemical reactions. In the photosynthetic bacteria Chlorobaculum tepidum, a member of the green sulfur bacteria family, light is absorbed by large antenna complexes called chlorosomes to create an exciton. The exciton is transferred to a protein baseplate attached to the chlorosome, before migrating through the Fenna–Matthews–Olson complex to the reaction center. Here, it is shown that by placing living Chlorobaculum tepidum bacteria within a photonic microcavity, the strong exciton–photon coupling regime between a confined cavity mode and exciton states of the chlorosome can be accessed, whereby a coherent exchange of energy between the bacteria and cavity mode results in the formation of polariton states. The polaritons have energy distinct from that of the exciton which can be tuned by modifying the energy of the optical modes of the microcavity. It is believed that this is the first demonstration of the modification of energy levels within living biological systems using a photonic structure.

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Keywords

biophotonics, microcavities, photosynthetic bacteria, polaritons, strong coupling

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