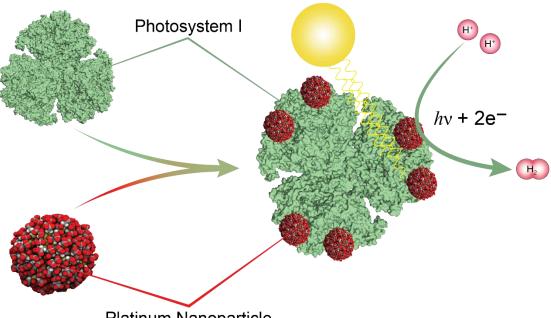
A Structural Approach to Engineering Biohybrid Photocatalysis

Maximino D. Emerson, Audrey M. Short, Siva naga Sai Damaraju, Joshua Vermaas, Lisa M. Utschig, Christopher J. Gisriel¹

¹Department of Biochemistry, University of Wisconsin-Madison. Madison, WI 53706, United States. ²Argonne National Laboratory, Lemont, IL 60439, United States. Chemical Sciences and Engineering Division. ³Biochemistry and Molecular Biology Department, Michigan State University, East Lansing, Michigan 48824, United States.

In oxygenic photosynthesis, two membrane protein complexes called photosystem I (PSI) and photosystem II perform solar-to-chemical energy conversion by using light to generate low potential electrons. When PSI is excited by light, its primary electron donor has a very low reduction potential, approximately -1.2 V. Platinum nanoparticles (PtNPs) designed to bind the surface of PSI are capable of harvesting these low potential electrons and catalyzing redox chemistry. These PSI-PtNP biohybrids have been shown to perform photocatalytic hydrogen production. Recently, structural data from one such biohybrid containing PSI from the cyanobacterium Synechococcus lividus provided indications of the specific interactions involved in PtNP binding while also highlighting inefficiencies in PtNP usage and placement on the PSI surface. We have since determined two additional PSI-PtNP biohybrid structures containing PSI from the cyanobacterium Thermosynechococcus vestitus and a chemically treated PSI-core from another cyanobacterium Synechococcus leopoliensis to further elucidate the nature of PSI-PtNP interactions. We are now using these structures to develop engineering strategies to most efficiently use PtNPs and maximize the rate of redox activity.



Platinum Nanoparticle