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Who Needs a Lipid? Using Amphiphilic Block Copolymers for Artificial Photosynthesis

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ABSTRACT

In photosynthesis, lipids and proteins serve as the organizing material organizing photonic chromophores to perform complex function. In this talk, I describe the ability of short--chain, amphiphilic block copolymers (ABC) as a matrix for organizing chromophores in a manner that replicates supramolecular photosynthetic light harvesting and energy transfer. We use block copolymers such as 2.5 kDa, Poly(ethylene oxide)--block--poly(butadiene) (PEO--b--PBD) to organize chromophores in sufficient proximity to undergo efficient energy transfer through a self--assembly process. ABC membrane materials have advantages over traditional lipid membranes, in particular demonstrating a greater amount of structural flexibility, and enhanced robust materials. In this work, we use ABC to generate nanocomposite micelles that exhibit high efficiency energy transfer and also generate supported membrane assemblies exhibiting >95% energy transfer efficiency (ETE). In addition, we demonstrate the flexibility of ABC by mimicking the organization and structure of a multi--component, multi--dimensional, light--harvesting antenna system from green photosynthetic bacteria resulting in supramolecular energy transfer in three dimensions. Lastly, we demonstrate the ability of generating responsive photonic assemblies using an environmentally responsive ABC, Poly(acrylic acid)--block--poly(butadiene) (PAA--b--PBD). Nanocomposites generated via such ABC have a demonstrated ability to tune ETE via environmental conditions functionally mimicking regulatory processes observed in natural photosynthesis to alleviate photonic stress. In all, our described research demonstrates how the unique properties of short--chain ABC serve in generating membrane materials for coordinating photonic chromophores through self--assembly and the potential of such materials in mimicking other complex biological processes.

BIO:

Dr. Gabriel Montaño is a native New Mexican born and raised in Gallup, NM. Dr. Montaño attended New Mexico State University where he received his Bachelors of Science in Biology in 1997. He then attended Arizona State University where he completed his PhD in the lab of Dr. Robert Blankenship in 2002 in the Department of Chemistry and Biochemistry. Upon completion of his PhD., Dr. Montaño accepted a postdoctoral appointment in biomatierals design with Dr. Andy Shreve at Los Alamos National Laboratory where Dr. Montaño was an Intelligence Community Postdoctoral Fellow. In 2005, Dr. Montaño accepted a position as a Technical Staff Member with the newly developed Center for Integrated Nanotechnologies where he currently resides. Dr. Montaño's lab group investigates membrane biophysics. In particular, they are interested in bio- and bio-synthetic interfaces and supramolecular structure/function relationships. Many biological processes rely on complex interfacial interactions to drive function ranging from infectious diseases to organ function and complex processes such as photosynthesis. Understanding and mimicking such interactions are the focus of the Montaño team. In addition, Gabriel is also devoted to outreach initiatives, in particular enhancing diversity in STEM fields. Among his outreach efforts, Gabriel has served as the President of the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) (2015-16) as well as served as a SACNAS Board of Directors Member (2011-2014), a member of the Minority Affairs Committee of the Biophysical Society and as a member of the Hispanic Association of Colleges and Universities (HACU) STEM task force.