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Novel Applications of Bolaamphiphile Self-Assemblies: Catalyst, Sensors, and Light-Harvesting Systems Exploiting Biochemical Activities

Sang-Yup Lee

Department of Chemical and Biomolecular Engineering, Yonsei University, Republic of Korea
(Email: leessy@yonsei.ac.kr)

Peptidic bolaamphiphilic molecule is an amphiphilic molecule that has two hydrophilic amino acids at both ends of central hydrophobic moiety. Because of its symmetric structure, the peptidic bolaamphiphile self-assembly produces complex self-assembled suprastructures such as spheres and tubes. These peptidic bolaamphiphile self-assemblies attracts research interests for their potential applicability in engineering uses. The biochemical activity of those amino acids or peptides displays extraordinary functionality that can be exploited for various engineering fields. These peptidic bolaamphiphile self-assemblies have a lot of advantages; first, design of the molecular structure was available by selecting proper amino acid and hydrophobic chain. Diversity of amino acid including short peptide allows various design of bolaamphiphiles. Second, the peptidic bolaamphiphile self-assembly has fairly high mechanical strength that was not collapsed under vacuum and dry condition. This mechanical stability makes the self-assemblies attractive for the preparatioin of engineering materials. Finally, the biochemical/chemical functionality of surface-exposed amino acid can be exploited for the chemical and biological reactions. Thus, production of biomimic substances can be achieved with ease. Based on these advantages, some applications of the peptidic bolaamphiphile self-assemblies are to be discussed in this seminar. A self-assembly of histidyl bolaamphiphile was applied for the preparation of an enzyme-mimetic catalyst. Catalyst were simply developed by coordination with transition metal ions. The prepared catalysts were applied for CO_2 sequestration. Tyrosyl bolaamphiphile was applied for the development of a photoluminescent sensor with anntenna effect. This photoluminescent sensor was applied for the detection of a specific nitroaromatic compound and for a light-harvesting system. These applications demonstrated a novel way to use the amphiphilie self-assemblies exploiting the surface-exposed biochemical functional group of amino acid.