論文内容の要旨

論文題目： Photoelectrochemical Properties of Fullerene Derivatives and Application to Photocurrent Conversion Systems

［フラーレン誘導体の光電気化学的特性と光電流発生システムへの応用］

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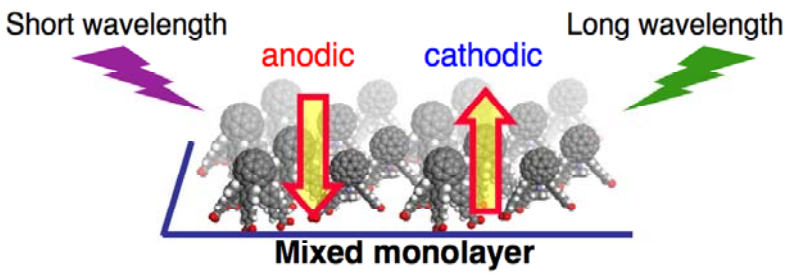
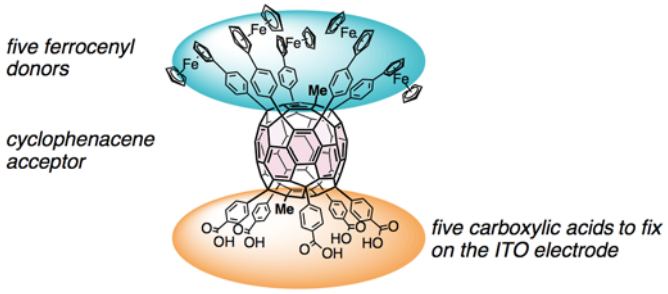
The present thesis describes the development of new functional molecular layers by using fullerene derivatives for effective and multi-functional photocurrent conversion systems.

In order to accomplish photocurrent conversion systems with high performance and multiple functionalities, applicable molecular properties and molecular assemblies are required. In chapter 1, the author argues that precise molecular design utilizing the unique electrochemical and structural properties of fullerene is essential to induce the distinguished photophysical properties and formation of layers, leading to the fabrication of desired molecular devices.

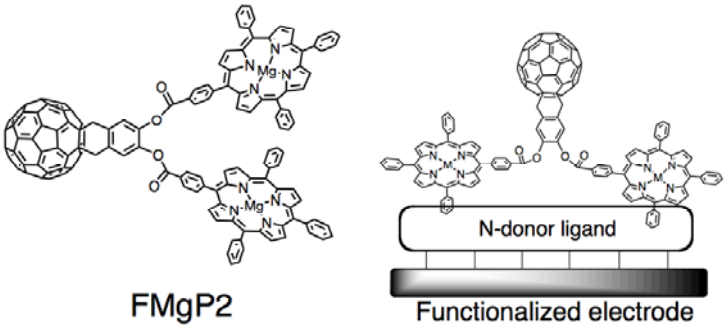
Chapter 2 describes synthesis of various [60] and [70]fullerene derivatives and evaluation of photocurrent conversion properties of molecular layers composed of these materials. Based on these results, the author constructed multi-functional molecular layers from two fullerene derivatives. The device consists [60]fullerene multi adduct that generates anodic current and [70]fullerene iron complex that generates cathodic current. This system exhibited anodic current under short-wavelength light and cathodic current under long-wavelength light with respectable photocurrent density because of less intermolecular cross-talk between each rigid components.



Chapter 3 describes the multi-functional fullerene derivatives synthesized by introducing functional groups in two steps. The deca(organo)[60]fullerene possessing five ferrocenyl exhibited long lifetime of charge separated state and was fixed on the ITO electrode surface to form a bilayer device via van der Waals interaction between ferrocenyl groups. The obtained layer exhibits high photocurrent conversion performance contributed by the long-lived charge separated state and large surface coverage on an electrode.



Chapter 4 describes construction of donor-acceptor conjugated system including magnesium porphyrin as a donor material with fullerene. Magnesium porphyrin unit interacts with the N-donor ligand immobilized on electrodes to form a supramolecular bilayer with high photocurrent conversion performance. This is the first example of photocurrent generation using the molecular layer of magnesium porphyrin. In this system, magnesium porphyrin produces much higher performance than zinc porphyrin, which is commonly used in similar photocurrent conversion systems.



Chapter 5 ends this thesis describing a conclusion and a future perspective.