Crossroads between Organic Electronics and Solid-State Electrochemistry

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Abstract

Solid-state electrochemistry (SSE) is a comprehensive discipline which covers various topics from fundamental sciences to practical applications. In conventional SSE, the potential difference between the working and counter electrodes induces electric double layers (EDLs) on the electrode active materials and then their redox reactions. The former is attracting much attention in organic electronics, because the EDLs, formed at solid-electrolyte interfaces, induce extremely large electric fields, through which effective carrier injection and charge separation can be realized.

In this presentation, we describe our recent works on the organic field-effect transistors (FETs) with gate dielectrics of ionic liquids,[1] which possess excellent features, such as wide electrochemical window, low vapor pressure, and high chemical and physical stability. We discuss the mobilities and threshold voltages in the EDL-FETs, and their dependence on the ionic liquids. Secondly, we describe the anomalous transient photocurrent in the organic photocells with a structure of [metal 1 | semiconductive layer | insulating layer | metal 2].[2-5] This type of photocurrent can be applicable to optoelectric conversion for optical communication. By adopting ionic liquids as the insulating layer, we found a significant enhancement of the transient current and realized ITO-free organic photocells. We also report the polarization process of an organic ferroelectric material and a large net field, which was induced in a [metal | semiconductive layer | ferroelectric layer | semiconductive layer | metal] structure. This field facilitated an effective charge separation and a large photocurrent with a photoresponsivity of ~0.1 mA W^{-1}.[6]

References

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