Electrochemical and Catalytic Studies of Cysteine Oxidation Induced by an Organic p-n bilayer both under Illumination and in the Dark

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As found recently by our group, dual-functional catalysis represents a specific chemical process that can induce a redox reaction not only under illumination but also in the dark. In a previous study, an organic p-n bilayer, comprising 3,4,9,10-perylenetetracarboxylic-bis-benzimidazole (PTCBI) and cobalt(II) phthalocyanine (CoPc), was utilized as a catalyst in the presence of 2-mercaptoethanol. Amino acids are attractive targets for studying dual catalysis because they bear various electron-donating groups such as $-\text{COOH}$, $-\text{NH}_2$, $-\text{OH}$, and $-\text{SH}$. In this work, cysteine (Cys) was subjected to dual catalysis reaction assisted by the PTCBI/CoPc bilayer. Similar to the aforementioned study, the organo-bilayer showed dual-catalytic activity for the oxidation of Cys along with the reduction of H^+ to H_2 , where the Cys oxidation can be considered to occur at the top end of the valance band ($\text{Co}^{\text{III}}\text{Pc}$) and at the bottom end of the conduction band ($\text{Co}^{\text{II}}\text{Pc}$) with and without irradiation, respectively. Based on the results obtained by employing serine (Ser) as a reference compound, it appeared that the dissociated thiol group of Cys is responsible for the dual catalysis by the organo-bilayer.

Keywords: organic semiconductors; p-n bilayer; photocatalysis; catalysis; cysteine

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