

Preparation and photoelectrochemistry of ITO/PEN composite electrodes modified with perylenediimide derivatives.

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Background. The water oxidation reaction is a necessary step for artificial photosynthesis to utilize water as an electron donor. Since this reaction is an endergonic reaction that does not proceed spontaneously, it is necessary to invest energy. As previous studies on water oxidation reaction, the photooxidation of water has been reported which uses PMPDI, a perylenediimide with phosphate groups, as a dye and CoOx as a catalyst. In this study, PMPDI and BTPDI, a novel perylenediimide, were synthesized (Fig. 1). These perylenediimides were spin-coated on ITO / PEN to prepare modified electrodes, and their photoelectrochemical behaviors were examined.

Preparation. PMPDI and BTPDI were synthesized according to references 1 and 2, respectively. The modified electrode was immersed in a base piranha solution consisting of 30% H₂O₂ aqueous solution, 28% NH₃ aqueous solution, and ultrapure water = 1: 1: 5 for 1 hour as a pretreatment. The PMPDI solution was dissolved in KOH solution, and the BTPDI solution was dissolved in CHCl₃. The two prepared solutions were spin-coated to fabricate the modified electrodes. CoOx was deposited on these modified electrodes by electrolysis with irradiation by green LED lights ($\lambda_{\text{max}} = 513 \text{ nm}$).

Surface observation and electrochemical evaluation. The SEM images of the modified electrodes revealed that the electrode coated with PMPDI was covered with the catalyst CoOx (Fig. 2). On the other hand, the BTPDI-modified electrode did not show the electrodeposition of CoOx. CV measurements were performed with and without light irradiation by the green LED (Fig. 3). The PMPDI-modified electrode showed an oxidation wave at +1.1 V. On the other hand, the BTPDI-modified electrode did not show the oxidation wave.

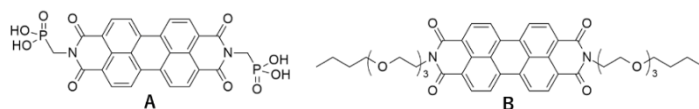


Fig.1 Structures of PMPDI (A) and BTPDI (B).

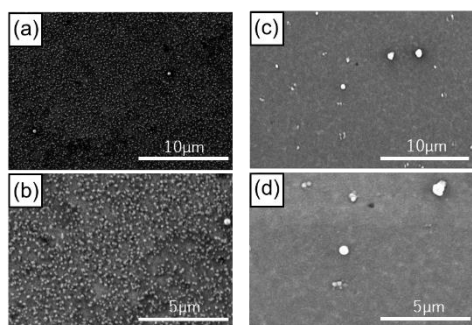


Fig.2 Surface observation of electrodes using SEM.
(a) Low magnification PMPDI electrode. (b) High magnification PMPDI electrode. (c) Low magnification BTPDI electrode. (d) High magnification BTPDI electrode.

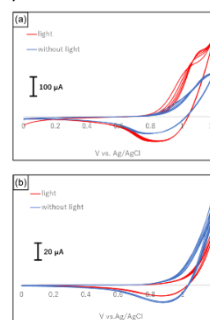


Fig.3 CV measurement results of (a) PMPDI electrode and (b) BTPDI electrode.

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