# 염료감응형 광전기화학 물분해 전지용 Tri-branched tri-anchoring organic dye 개발

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# Tri-branched tri-anchoring organic dye for Visible light-responsive dye-sensitized photoelectrochemical water-splitting cells

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Photoelectrochemical (PEC) systems are promising methods of producing H2 gas using solar energy in an aqueous solution. The photoelectrochemical properties of numerous metal oxides have been studied. Among them, the PEC systems based on TiO2 have been extensively studied. However, the drawback of a PEC system with TiO2 is that only ultraviolet (UV) light can be absorbed because of its large band gap (3.2 – 3.4 eV). Two approaches have been introduced in order to use PEC cells in the visible light region. The first method includes doping impurities, such as nitrogen, into TiO2, and this technique has been extensively studied in an attempt to narrow the band gap. In comparison, research on the second method, which includes visible light water splitting in molecular photosystems, has been slow. Mallouk et al. recently developed electrochemical water-splitting cells using the Ru(II) complex as the visible light photosensitizer. the dye-sensitized PEC cell consisted of a dye-sensitized TiO2 layer, a Pt counter electrode, and an aqueous solution between them. Under a visible light (< 3 eV) illumination, only the dye molecule absorbed the light and became excited because TiO2 had the wide band gap. The light absorption of the dye was followed by the transfer of an electron from the excited state (S*) of the dye to the conduction band (CB) of TiO2 and its subsequent transfer to the transparent conducting oxide (TCO). The electrons moved through the wire to the Pt, where the water reduction (or H2 evolution) occurred. The oxidized dye molecules caused the water oxidation because their HOMO level was below the H2O/O2 level. Organic dyes have been developed as metal-free alternatives to the Ru(II) complexes because of their tunable optical and electronic properties and low-cost manufacturing. Recently, organic dye molecules containing multi-branched, multi-anchoring groups have received a great deal of interest. In this work, tri-branched tri-anchoring organic dyes (Dye 2) were designed and applied to visible light water-splitting cells based on dye-sensitized TiO2 electrodes. Dye 2 had a molecular structure containing one donor (D) and three acceptor (A) groups, and each ended with an anchoring functionality. In comparison, mono-anchoring dyes (Dye 1) were also synthesized. The PEC response of the Dye 2-sensitized TiO2 film was much better than the Dye 1-sensitized or unsensitized TiO2 films.

**Key words :** photoelectrochemical water-splitting cells, Multi Anchoring Group, Dye-sensitizer

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