非水系電解液中のレドックス電位が $Zn_xCd_{1-x}Se$ 粉末光アノードの光電気化学特性に与える影響

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Effects of redox potential in a nonaqueous electrolyte on photoelectrochemical properties of a particulate $Zn_xCd_{1-x}Se$ photoanode ([1]*Faculty of Engineering, Shinshu University*, [2]*Research Initiative for Supra-Materials,* [3]*The University of Tokyo*) ○Hiroto Takano,[1] Mika Nishizawa,[1] Yosuke Kageshima,[1,2] Katsuya Teshima,[1,2] Kazunari Domen,[2,3] Hiromasa Nishikiori[1,2]

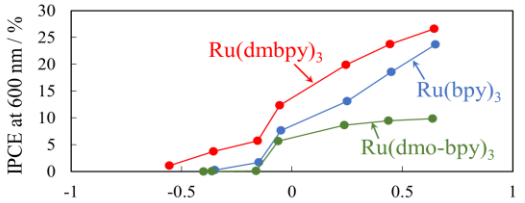
Photoelectrochemical (PEC)-photovoltaic cells consisting of a particulate $Zn_xCd_{1-x}Se$ photoanode in a nonaqueous electrolyte have been reported to generate higher photovoltage than 1.23 V via a one-step photoexcitation process[1]. Since the photovoltage obtained by such cells reflects the difference between the Fermi-level of the semiconductor and the redox potential (E_{redox}) in the electrolyte, the E_{redox}, as well as the band structure of the photoanode, should affect the photovoltaic performances.

In this study, we evaluated the effects of E_{redox} of various ruthenium complexes containing different ligands on the PEC properties of the photoanodes. It was found that the utilization of $Ru(dmbpy)_3$ complex with slightly negative equilibrium potential compared to $Ru(bpy)_3$ improved the onset potential and the incident-photon-to-current conversion efficiency (IPCE) of the $Zn_{0.25}Cd_{0.75}Se$ photoanode (Fig. 1). In the presentation, stability of the photoanode and selectivity of the PEC reaction will be also discussed in detail.

Keywords : Nonaqueous Photoelectrochemical Cell; Photoelectrochemical Properties; Redox Potential; Photocatalyst; Photovoltage

$Zn_xCd_{1-x}Se$ 粉末光アノードから成る非水系湿式太陽電池は、一段階光励起過程で 1.23 V 以上の高い起電力を発電可能であることが報告されている[1]。本系で得られる光起電力は半導体のフェルミ準位と溶液中のレドックス電位(E_{redox})との差が反映されるため、光アノードのバンド構造だけでなく、溶液中のレドックス電位も発電特性に寄与し得ると考えられる。

本研究では、異なる配位子を有する様々な Ru 錯体の E_{redox} が、光アノードの光電気化学特性に与える影響について評価した。$Ru(bpy)_3$ に比べやや卑な平衡電位を有する $Ru(dmbpy)_3$ 錯体を用いることで、$Zn_{0.25}Cd_{0.75}Se$ 光アノードのオンセット電位や量子効率(IPCE)が改善することが分かった(Fig.1)。発表では、光アノードの耐久性や光電気化学反応の選択性についても詳細に議論する。



	$Ru(bpy)_3$	$Ru(dmbpy)_3$	$Ru(dmo\text{-}bpy)_3$
E_{redox} / V vs. Fc/Fc^+	0.90	0.74	0.55

Fig. 1 IPCE-potential curves for the $Zn_{0.25}Cd_{0.75}Se$ photoanode in non-aqueous electrolytes containing various Ru complexes.

1) Y. Kageshima, *et. al.*, *Sustainable Energy Fuels* **2019**, *3*, 2733.