非水系湿式太陽電池の発電特性向上を志向した $Zn_xCd_{1-x}Se$ ナノワイヤー光アノードの開発

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Development of $Zn_xCd_{1-x}Se$ nanowire photoanodes intended for improved photovoltaic performances of nonaqueous photoelectrochemical cells ([1]*Faculty of Engineering, Shinshu University,* [2]*Research Initiative for Supra-Materials, Shinshu University,* [3]*The University of Tokyo*) ○Koki Miyama,[1] Hiroto Takano,[1] Mika Nishizawa,[1] Yosuke Kageshima,[1,2] Katsuya Teshima,[1,2] Kazunari Domen,[2,3] Hiromasa Nishikiori[1,2]

We have reported a nonaqueous photoelectrochemical cell capable of generating larger photovoltage than the thermodynamic onset voltage for water splitting *via* one-step photoexcitation process with using a particulate $Zn_xCd_{1-x}Se$ photoanode. However, since the external quantum efficiency was only 10-20 %, there was still room for improvement. In this study, we developed $Zn_xCd_{1-x}Se$ nanowire photoanodes for the improved photocurrent.

The current-potential curves in nonaqueous electrolyte obtained from $Zn_xCd_{1-x}Se$ nanowire photoanodes synthesized at different temperatures are shown in Fig. 1. All specimens showed anodic photocurrent under simulated sunlight. The photocurrent increased according to the increasing of the synthesis temperature, resulted in the maximum performances at 600 °C. This may be attributed to the increased crystallinity of the light-absorbing layer due to synthesis at high temperatures. In the presentation, the effects of synthesis conditions of the nanowire and surface modifications on the photoelectrochemical performances will also be discussed.

Keywords : Photocatalysts; Photoanodes; Nanowire; Surface modification; Photoelectrochemical cells

$Zn_xCd_{1-x}Se$ 粉末光アノードを用いることで、一段階光励起過程で水の理論電解電圧以上の高光起電力を発電可能な非水系湿式太陽電池を報告している[1)]。しかし外部量子効率は 10～20 %程度であり、改善の余地が残る。本研究では、$Zn_xCd_{1-x}Se$ のナノワイヤー化による光電流値の向上を試みた。

異なる温度で合成した $Zn_xCd_{1-x}Se$ ナノワイヤー光アノードの、非水系電解液中における電流-電位曲線を Fig. 1 に示す。いずれのサンプルも疑似太陽光照射下で酸化的な光電流を示した。合成温度の上昇に伴って光電流値は向上し、600 ℃において最大の特性を示した。これは、高温での合成による光吸収層の結晶性向上に起因すると考えられる。発表では、合成条件や表面修飾が光電気化学特性に及ぼす影響についても報告する。

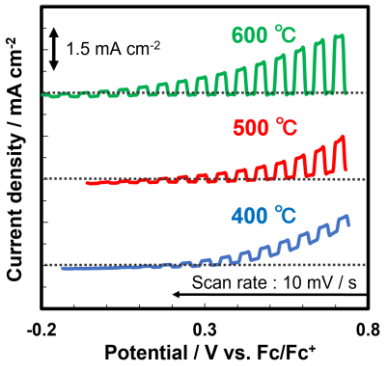

Fig. 1. Current-potential curves of $Zn_xCd_{1-x}Se$ nanowire photoanodes synthesized at different temperatures under simulated sunlight in non-aqueous electrolyte.

1) Y. Kageshima, *et. al.*, *Sustainable Energy Fuels* **2019**, *3*, 273.