LIGHT-DRIVEN OXIDATION OF GLYCEROL ON WO_3 -BASED PHOTOANODES FOR SUSTAINABLE APPLICATIONS

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The increasing production of biodiesel has led to a substantial surplus of glycerol as an unavoidable by-product [1]. Crude glycerol streams, often containing methanol, inorganic salts, and fatty acid residues, pose disposal challenges and contribute to industrial wastewater pollution. At the same time, glycerol is an underutilized bio-derived carbon resource that is attractive for sustainable oxidation processes due to its non-toxicity, biodegradability, and high reducing capacity [2]. Selective oxidation of glycerol provides access to a broad range of oxygenated C3–C1 products, including value-added C3 compounds such as glyceraldehyde, dihydroxyacetone, and glyceric acid, C2 intermediates like glycolaldehyde arising from C–C bond cleavage, and deeper oxidation products such as formic acid [3]. However, conventional oxidation methods typically rely on harsh oxidants, suffer from limited selectivity, and generate secondary waste streams. Photoelectrochemical oxidation using semiconductor photoanodes offers a greener alternative by harnessing solar energy and operating in non-toxic aqueous electrolytes (Fig. 1A), enabling controlled oxidation under mild conditions.

In this study, WO_3 photoanodes were synthesized using a hydrothermal approach and characterized using complementary structural and morphological techniques to assess their phase composition and optical properties. The photoelectrochemical behaviour of the prepared WO_3 electrodes was investigated in neutral Na_2SO_4 electrolyte under controlled illumination and applied potential, both in the absence and presence of glycerol.

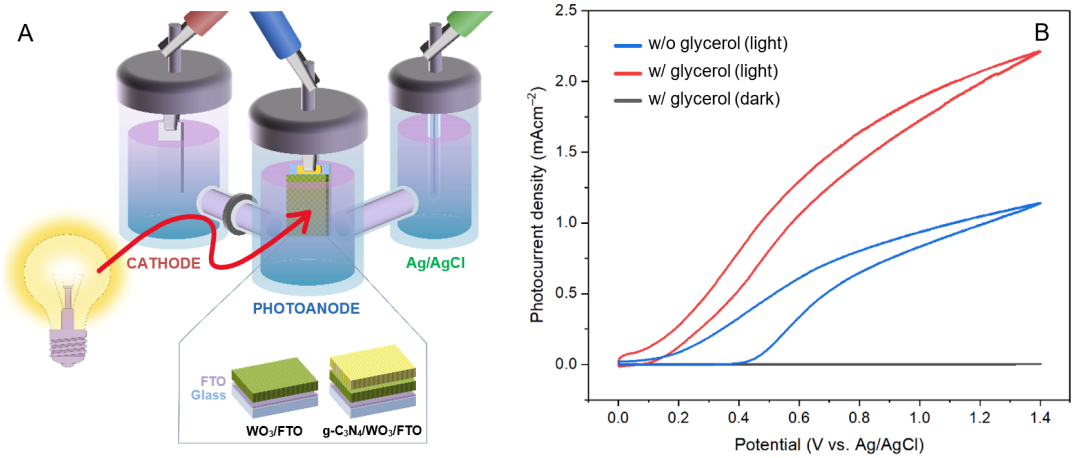

Fig. 1. (A) Setup of photoelectrochemical system, consisting of a three-compartment cell, electrodes immersed in electrolyte and a light source. (B) Cyclic voltammograms of WO_3 photoanode in 0.1 M Na_2SO_4 with and without 0.1 M glycerol recorded in dark and under illumination (1 sun, AM 1.5G illumination),potential scan rate: 50 mV/s.

Preliminary cyclic voltammetry measurements (Fig. 1B) reveal a pronounced enhancement of the photoanodic current upon glycerol addition, indicating a strong influence of glycerol on interfacial charge-transfer processes at illuminated semiconductor electrodes. This behaviour is commonly explained by the ability of glycerol to scavenge photogenerated holes on the semiconductor surface, thereby suppressing electron–hole recombination while simultaneously acting as an effective electron donor. As a result, the photoanodic current is significantly enhanced compared to water oxidation.

Building on this observation, the present work aims to systematically investigate photoelectrochemical glycerol oxidation on WO_3-based photoanodes under visible-light irradiation. At the conference, results on anode modification strategies, including WO_3/g-C_3N_4 systems, electrolyte composition effects, and chromatographic analysis of glycerol oxidation products will be reported.

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