

Área: FIS

Photoelectrocatalytic Glycerol Oxidation over Ni/Nb₂O₅-Graphene Electrodes

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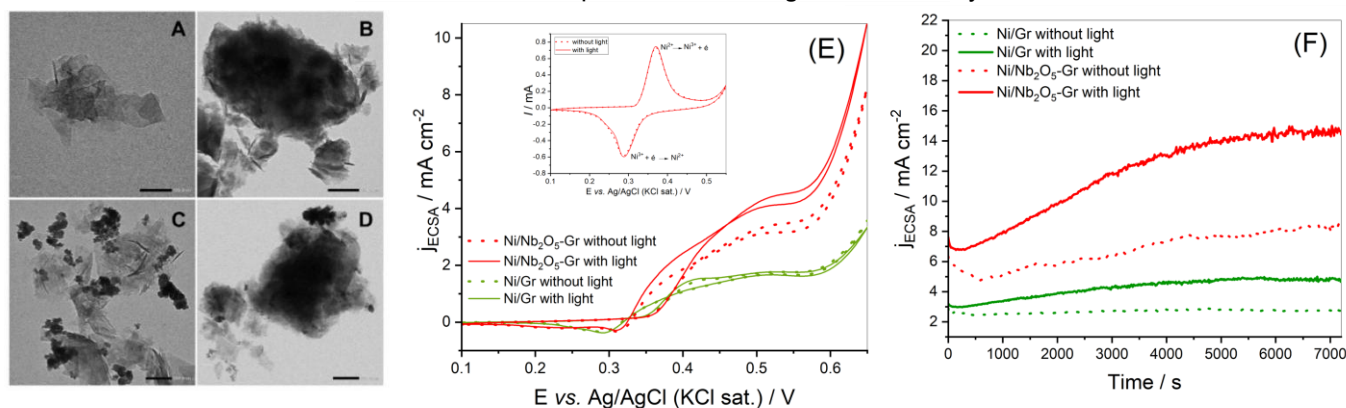
Highlights

Glycerol oxidation as a low-energy alternative to OER. Enhanced photoelectrocatalytic activity under UV irradiation

Abstract

Glycerol (GLY), an abundant byproduct of biodiesel production, has attracted considerable interest in the field of electrocatalysis. Its utilization is appealing both for the synthesis of higher value-added chemicals and for application in energy conversion due to its high energy density, safety, and ease of storage. However, the slow kinetics of GLY electrooxidation reactions (GER) demand efficient, stable, and low-cost catalysts. Ni-based materials are promising options, showing high activity in alkaline media while avoiding noble metals. Performance can be enhanced by graphene (Gr), which improves surface area and conductivity, and Nb₂O₅, which adds chemical stability and photoelectrochemical response due to its high radiation absorption properties. In this study, Ni/Gr and Ni/Nb₂O₅-Gr were synthesized by the polyol method and applied to GER under alkaline conditions. Their photoelectrochemical performance was evaluated using cyclic voltammetry (CV) and chronoamperometry (CA) under dark and UV light ($\lambda = 365$ nm). A GCE L-type (0.071 cm²) was used as working electrode, a Pt wire as the counter electrode and an Ag/AgCl as reference electrode. TGA and TEM confirmed Ni(OH)₂ formation as large agglomerates on the supports, while AAS showed Ni contents of 3.6% (Ni/Gr) and 4.1% (Ni/Nb₂O₅-Gr). DRS indicated a reduced Nb₂O₅ bandgap from 3.5 eV to 2.1 eV with Gr incorporation. Both catalysts displayed activity toward GER (1.0 mol L⁻¹ KOH and 0.1 mol L⁻¹ GLY), with Ni/Nb₂O₅-Gr achieving higher efficiency under irradiation. Stability tests (2000 cycles and 2 h CA) confirmed robust behavior, although with signs of surface poisoning by GER intermediates. When evaluated in crude industrial GLY, both catalysts were able to promote the GER even in the presence of impurities, with Ni/Nb₂O₅-Gr standing out due to its enhanced catalytic efficiency under UV irradiation. These findings indicate that the catalysts hold strong potential for application in the photoelectrooxidation of GLY in alkaline media.

Figure 1 - TEM images of (A) Gr, (B) Ni/Gr, (C) Nb₂O₅-Gr, and (D) Ni/Nb₂O₅-Gr; (E) CV profiles of GER in crude GLY (100th scan) in the absence and presence of UV light for the catalysts; (F) CA curves of GER in pure GLY in the absence and presence of UV light for the catalysts.



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