Ethylene glycol electrooxidation reaction on silver surfaces modified with low noble metal content

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The electrooxidation of ethylene glycol (EG) in alkaline media represents a promising route for sustainable energy generation using direct alcohol fuel cells (DAFCs), owing to EG's high energy density, low toxicity, and renewable origin [1,2]. This study investigates the synthesis and electrochemical performance of silver (Ag) surfaces modified with low contents of Pd, Pt, Au, and Ta, aiming to enhance catalytic activity and long-term durability [3]. The Ag/C electrode exhibited low electrocatalytic activity, whereas its combinations with Pd and Pt significantly improved performance. Among the synthesized materials, the PdAuAg/C catalyst displayed the highest activity, reaching a peak current density of 120 $mA \cdot cm^{-2}$ with good cycling stability, suggesting strong synergistic and bifunctional effects. In contrast, Pd/C (Etek) and PdTa/C showed inferior performance and clear signs of deactivation. Although Pt/C (Etek) achieved the highest initial current (>150 $mA \cdot cm^{-2}$), it also experienced current decay, in line with the known stability limitations of platinum-based systems [2]. Chronoamperometric tests supported these findings, with PdAuAg/C and AgAu/C maintaining currents above 30 $mA \cdot cm^{-2}$, outperforming both monometallic and commercial benchmarks. These results highlight the potential of multimetallic catalysts supported on modified carbon materials as durable and efficient platforms for EG oxidation in alkaline media [3].

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References:

[1] J.J. Zhao, H.R. Zhu, C.J. Huang, M.H. Yin, G.R. Li, *J. Mater. Chem. A*, 13, 3236 (2025).

[2] F.M. Souza, V.S. Pinheiro, T.C. Gentil, L.E.B. Lucchetti, J.C.M. Silva, M. L.M.G. Santos, I. De Oliveira, G. Amaral-Labat, M.C. Santos, *J. Electroanal. Chem*. 922, 116712 (2022).

[3] L. Demarconnay, S. Brimaud, C. Coutanceau, J.M. Léger, *J. Electroanal. Chem.* 601, 169 (2007).