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Evaluation of Ti/RuO_2, Ti/IrO_2 and Ti/Nb_2O_5 Anodes for Photoelectrocatalytic Degradation of Diuron in Ethanolic Medium

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Conventional water treatments often fail to fully remove pollutants, leading to advances in alternative methods. While most studies focus on aqueous systems, some explore non-aqueous solvents [1,2]. This study systematically compares Ti/RuO_2, Ti/IrO_2, and Ti/Nb_2O_5 anodes for the degradation of the herbicide diuron in an ethanolic medium using electrocatalysis (EC), photocatalysis (PC), and photoelectrocatalysis (PEC). The anodes, except for the commercial Ti/RuO_2 electrode, were synthesized via the thermal decomposition method. Performance was evaluated based on degradation efficiency, reaction kinetics, energy consumption, and synergistic effects. In EC, Ti/RuO_2 was the most effective, with 60.3% removal. Under PC, all anodes performed well, with Ti/RuO_2 achieving the highest degradation (98.2%). In the combined PEC process, both Ti/RuO_2 (98.5%) and Ti/IrO_2 (98.2%) demonstrated high efficiency. Notably, only the Ti/IrO_2 anode exhibited a significant synergistic effect (SI=1.45). Conversely, the Ti/Nb_2O_5 anode, while effective in PC (91.5%), showed poor electrocatalytic activity and a less effective performance in the combined system. Analysis of byproducts revealed the formation of several intermediates, with some exhibiting higher toxicity and bioconcentration potential than the parent diuron molecule. This work underscores that while Ti/RuO_2 is a versatile anode, the synergistic behavior of Ti/IrO_2 makes it a highly promising option for photoelectrocatalytic treatment in non-aqueous media.

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