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Doping effects on the electro-degradation of phenol on doped titanium suboxide anodes#

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Abstract Titanium suboxide is an excellent electrode material for many oxidization reactions. In this article, the electrodes of pure Ti_4O_7, doped Ti_4O_7 and the mixed-crystal of Ti_4O_7 and Ti_5O_9 were prepared to evaluate their activities and doping effects in the electro-degradation of phenol. It was revealed by the HPLC analysis results that the degradation intermediates and routes were significantly affected by the doping element. On the pure Ti_4O_7 anode, a series of classic intermediates were obtained from benzoquinone and hydroquinone to various carboxylic acids. These intermediates were degraded gradually to the final organic intermediate of oxalate in all experiments. At last, oxalate was oxidized to CO_2 and H_2O. Distinctively, the Y-doped Ti_4O_7 anode directly broke phenol to α-ketoglutaric acid without the intermediates of benzoquinone and hydroquinone. The strong oxidization ability of the Y-doped Ti_4O_7 anode might be responsible for the highest COD removal ratio. In contrast, the Ga-doped Ti_4O_7 anode showed the worst degradation activity in this article. Three intermediates of benzoquinone, hydroquinone and meliec acid were found during the degradation. Benefiting from the weak ability, oxalate was efficiently accumulated with a very high yield of 74.6%. The results demonstrated promising applications from electrochemical preparation to wastewater degradation by adjusting the doping reagent of Ti_4O_7 electrodes.

Keyword titanium suboxide, electro-oxidation, doping effect, phenol, oxalate

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