Enhancement of chlorine on Pd catalyst for H₂O₂ in-situ synthesis in electro-Fenton system: Kinetics and Mechanism

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Abstract

Palladium-based catalyst has been widely employed in electro-Fenton process for in-situ generation of H₂O₂. However, the selectivity to H₂O₂ achieved so far is still far below application level. In this work, a series of Cl-FePd/ γ -Al₂O₃/Al catalysts were prepared by a three-step-impregnation method, exhibiting excellent activity in H₂O₂ in-situ synthesis and high efficiency in phenol degradation. The characterization results showed that the Cl could assist in increasing the content of Pd⁰ and reducing the isoelectric point of catalyst, leading to the dramatic promotion in synthesis of H₂O₂. Moreover, theoretical calculation and kinetics further demonstrated that the Cl doping could facilitate the main reaction in H₂O₂ synthesis, as well as inhibit side reactions, including the dissociation of O-O bond, hydrogenation and decomposition. Furthermore, plausible mechanism and degradation pathways were elaborated based on ESR and GC-MS results. These findings illustrate the value of palladium-based Cl-FePd/ γ -Al₂O₃/Al catalyst in its application in electro-Fenton process.

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