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能源和环境工程

不同金属氧化物膜电极上苯酚的电催化氧化

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摘要

分别以自制的金属氧化物膜电极Ti/SnO2+Sb2O3、Ti/SnO2+Sb2O3/PbO2和Ti/SnO2+Sb2O3/RuO2+PbO2为阳极，恒电流电解低浓度苯酚溶液，研究了不同金属氧化物阳极对苯酚电催化氧化过程的影响。实验结果表明：在实验条件下，苯酚溶液在3种金属氧化物膜电极上的电催化氧化过程的宏观动力学符合一级反应动力学规律，但不同金属氧化物阳极上苯酚电催化氧化过程的表观反应速率及电流效率有明显的差异。25℃下苯酚在Ti/SnO2+Sb2O3、Ti/SnO2+Sb2O3/PbO2和Ti/SnO2+Sb2O3/RuO2+PbO2电极上电催化氧化的表观反应速率常数k分别为6.66×10-2min-1、2.49×10-2min-1和9.76×10-3min-1;瞬时电流效率随电解时间的增长而下降，初始电流效率分别为78.7%、38.9%、13.2%。以Ti/SnO2+Sb2O3电极为阳极电解60 min后，苯酚浓度从初始浓度2.13×10-3mol·L-1降至3.27×10-5mol·L-1，苯酚的转化率达98.5%;而在相同的反应条件下，以Ti/SnO2+Sb2O3/PbO2和Ti/SnO2+Sb2O3/RuO2+PbO2为阳极时，苯酚的转化率只有82.7%和29.8%。对3种电极在苯酚溶液中的伏安特性的研究表明，Ti/SnO2+Sb2O3电极具有比Ti/SnO2+Sb2O3/PbO2和Ti/SnO2+Sb2O3/RuO2+PbO2高的析氧电位，因此有利于有机物的氧化和过程电流效率的提高。

关键词 电催化氧化 苯酚 阳极

分类号

Electrocatalytic oxidation of phenol on several metal-oxide film electrodes

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Abstract

Ti/SnO2+Sb2O3, Ti/SnO2+Sb2O3/PbO2 and Ti/SnO2+Sb2O3/RuO2+PbO2 electrodes were prepared and the electrocatalytic oxidation of phenol was studied in acidic media on the electrodes by bulk electrolysis experiments under galvanostatic control.The results clearly showed that the oxidation reactions of phenol followed first-order kinetics at all of three kinds of electrodes under experimental conditions and the electrode materials produced remarkable effects on apparent reaction rate and instantaneous current efficiency (ICE) of electrocatalytic oxidation of phenol.The apparent rate constants for Ti/SnO2+Sb2O3, Ti/SnO2+Sb2O3/PbO2 and Ti/SnO2+Sb2O3/RuO2+PbO2 electrodes were 6.66×10-2 min-1 , 2.49×10-2min-1 and 9.76×10-3min-1 at 25℃, respectively, and the initial ICEs were 78.7%, 38.9% and 13.2% respectively.When Ti/SnO2+Sb2O3 electrode was used as anode and the phenol solution was electrolyzed for 60 min, the concentration of phenol decreased from 2.13×10-3 mol·L-1 to 3.27×10-5mol·L-1, and the conversion of phenol reached 98.5%, but the conversion was only 82.7% and 29.8% for Ti/SnO2+Sb2O3/PbO2 and Ti/SnO2+Sb2O3/[JP3]RuO2+PbO2 electrodes, respectively.The voltammograms of the anodes in the phenol solution revealed that there was a higher oxygen evolution potential for Ti/SnO2+Sb2O3 electrode, which was beneficial to the oxidation of organic compounds.

Key words electrocatalytic oxidation phenol anode

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