

研究报告

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$\text{Cu}_x\text{Ce}_{1-x}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ 催化剂催化燃烧甲苯性能的研究

Catalytic performance of copper and cerium oxides-based $\gamma\text{-Al}_2\text{O}_3$ on combustion of toluene

关键词: [甲苯](#) [Cu_xCe_{1-x}O₂](#) [催化燃烧](#) [γ-Al₂O₃](#)

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摘要: 以 $\gamma\text{-Al}_2\text{O}_3$ 为载体, 以复合氧化物 $\text{Cu}_x\text{Ce}_{1-x}\text{O}_2$ 为活性组分, 其中 $x=0.1, 0.2, 0.4, 0.6, 0.8$, 通过浸渍法制备了一系列 $\text{Cu}_x\text{Ce}_{1-x}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ 催化剂. 在固定床反应器中评价了催化剂对甲苯的催化活性, 通过XRD、SEM对催化剂进行表征, 并运用ICP-MS分析并计算Cu、Ce的摩尔比以及活性组分的负载量. 结果表明, 在 $\text{Cu}_x\text{Ce}_{1-x}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ 催化剂中Cu、Ce摩尔比的实际值与理论值相近, 活性组分的负载量在19%以上, 而且对甲苯都有较好的低温催化活性, 其中当 $x=0.2$ 时, 即 $\text{Cu}_{0.2}\text{Ce}_{0.8}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ 催化剂对甲苯的催化活性最高, 其中 $T_{10}=160\text{ }^\circ\text{C}$, $T_{90}=265\text{ }^\circ\text{C}$; 当甲苯的进口浓度在 $700\sim 3000\text{ mg}\cdot\text{m}^{-3}$ 时, 进口浓度对 $\text{Cu}_{0.2}\text{Ce}_{0.8}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ 催化剂的催化活性影响较小, 且经过连续80 h的稳定性操作后转化率仍然保持在90%以上.

Abstract: A series of catalysts, copper and cerium oxides-based $\gamma\text{-Al}_2\text{O}_3$, were prepared using $\text{Cu}_x\text{Ce}_{1-x}\text{O}_2$ ($x=0.1, 0.2, 0.4, 0.6$ and 0.8) as the active components and $\gamma\text{-Al}_2\text{O}_3$ as the carrier through an impregnation method. The catalytic activity of the novel catalysts for combustion of toluene was studied using a fixed bed reactor. The catalysts were characterized by X-ray diffraction (XRD) and Scanning Electron Microscopy (SEM). Meanwhile, the mole ratio of Cu to Ce and active component-supported value were analyzed by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The results showed that the measured mole ratio of Cu to Ce in the $\text{Cu}_x\text{Ce}_{1-x}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ catalyst was close to the theoretical value while the active component-supported value was higher than 19%. All catalysts showed excellent catalytic performance while the $\text{Cu}_{0.2}\text{Ce}_{0.8}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ catalysts exhibited the highest with T_{10} at $160\text{ }^\circ\text{C}$ and T_{90} at $265\text{ }^\circ\text{C}$. The results showed that the inlet concentration of toluene (ranged from 700 to 3000 $\text{mg}\cdot\text{m}^{-3}$) had insignificant effect on catalytic activity of the $\text{Cu}_{0.2}\text{Ce}_{0.8}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ catalyst. The $\text{Cu}_{0.2}\text{Ce}_{0.8}\text{O}_2/\gamma\text{-Al}_2\text{O}_3$ catalyst appeared to have a significant catalytic ability for combustion of toluene and can achieve over 90% of toluene removal efficiency after 80-hour flow test.

Key words: [toluene](#) [Cu_xCe_{1-x}O₂](#) [catalytic combustion](#) [γ-Al₂O₃](#)

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