

焙烧温度对 Ni/MgO 催化剂结构及其在甲苯二氧化碳重整反应中催化性能的影响

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摘要 考察了焙烧温度对 Ni/MgO 催化剂结构及其在甲苯二氧化碳重整反应中催化性能的影响。由于 NiO-MgO 固溶体的形成, 样品的 X 射线衍射谱中没有出现明显的 NiO 衍射峰, 而在拉曼光谱中出现明显的散射信号。X 射线光电子能谱、氢气程序升温还原和 H₂ 脉冲吸附结果表明, 高温焙烧过程中 Ni 向催化剂体相扩散, 与 MgO 发生强互相互作用, 使得 Ni 物种难以还原, 但部分位于催化剂表面的 Ni 物种能够还原; 高温焙烧后催化剂表面活性 Ni 物种明显减少, 致使催化剂重整活性降低。重整反应后, 催化剂表面存在少量多核芳烃类积炭, 这很可能是高温焙烧催化剂稳定性差的原因。

关键词: 焦油 二氧化碳 重整 镍 氧化镁 负载型催化剂 焙烧温度 拉曼光谱

Abstract: A Ni/MgO catalyst for CO₂ reforming of toluene was prepared by impregnating MgO with Ni(NO₃)₂. During calcination, some of the NiO diffused into the MgO and formed a solid solution structure of NiO-MgO, which was analyzed by Raman spectroscopy. In the temperature-programmed reduction with hydrogen analysis, only a small part of the Ni species in the outermost layer was reduced to metallic Ni at 700 °C. The calcination temperature played a key role in determining the subsequent catalytic activity of Ni/MgO, consequently the catalyst calcined at 600 °C had the highest activity. This catalyst also had the highest surface concentration of reduced Ni, which probably accounted for its high activity. During the reforming tests, a small amount of coke was deposited on Ni/MgO catalyst. Polyaromatic compounds were observed by Raman spectroscopy. The coke was probably responsible for the activity loss of Ni/MgO.

Keywords: tar, carbon dioxide, reforming, nickel, magnesium oxide, supported catalyst, calcination temperature, Raman spectroscopy

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