

助剂对泡沫金属微反应器内二甲醚水蒸气重整制氢的影响

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Effect of promoter on performance of hydrogen production from steam reforming metal foam microreactor

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摘要 采用共沉淀耦合机械混合法制备了CuO-ZnO-Al₂O₃/HZSM-5双功能催化剂用于二甲醚水蒸气重整制氢的研究,结合H₂-TPR、XRD、SEM等表征手段,在泡沫金属微反应器内考察助剂Cr、Zr、Ce、Co对双功能催化剂催化性能的影响。研究表明,加入Cr助剂后,可以有效降低催化剂的平均孔径和还原温度,并抑制催化剂制备过程中氢氧化锌晶相的形成,催化剂的催化性能明显提高,二甲醚的转化率和氢收率在较低温度下即可分别达到99%和95%,表现出了良好的低温反应活性。考察了反应温度、空速和水醚比等条件对二甲醚水蒸气重整催化剂催化活性的影响,在250℃、空速3 884 mL/(g·h)、水醚比为5的条件下,CuO-ZnO-Al₂O₃-Cr₂O₃/HZSM-5催化二甲醚水蒸气重整反应进行50 h,二甲醚的转化率维持在97%以上,催化剂的活性有明显下降。

关键词: 二甲醚水蒸气重整 泡沫金属 Cr助剂 泡沫金属微反应器

Abstract: The CuO-ZnO-Al₂O₃/HZSM-5 catalyst prepared by co-precipitation and mechanical mixing with HZSM-5 was used for hydrogen production from steam reforming of dimethyl ether. The effects of Cr, Zr and Ce promoters on catalyst performance were investigated by means of X-ray diffraction(XRD), temperature programmed reduction (H₂-TPR), SEM and BET. The results showed that addition of promoter can reduce the average pore diameter and reduction temperature of catalyst effectively, and inhibited the form of Zn(OH)₂ in the catalyst preparation process. The conversion of dimethyl ether and hydrogen yield reaches 99% and 95% respectively at low reaction temperature. The effects of reaction temperature, space velocity and steam-to-DME ratio were investigated. At the conditions of 250℃, the space velocity of 3 884 mL/(g·h), H₂O/DME=5, over 97% of DME conversion was obtained over the CuO-ZnO-Al₂O₃-Cr₂O₃/HZSM-5 catalyst and the catalytic activity has no obvious deactivation during 50 h durability test.

Key words: steam reforming of dimethyl ether metal foam Cr promoter metal foam microreactor

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