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研究论文

Cu/NiO-V_2O_5/SiO_2催化剂光催化CO_2和甲醇合成碳酸二甲酯的研究

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摘要 采用表面改性法和等体积浸渍法制备了NiO-V_2O_5/SiO_2和Cu/NiO-V_2O_5/SiO_2光催化剂. 用TPR, XRD, UV-Vis DRS, IR和TPD-MS技术对催化剂的结构、吸光性能和化学吸附性能进行了表征, 研究了催化剂上CO_2和甲醇光促表面催化反应的反应性能. 结果表明, 半导体NiO和V_2O_5复合后部分形成了Ni^{2+}—O—V^{5+}键联, 而且NiO和V_2O_5在催化剂表面有相互修饰作用, NiO的加入有助于提高V_2O_5在载体SiO_2表面的分散程度, 抑制V_2O_5的聚集, 而且金属Cu和NiO的引入扩展了催化剂的光响应范围. 在催化剂表面存在多种活性吸附位, 催化剂对CO_2和甲醇的有效吸附使得其在较低温度下就能促进碳酸二甲酯的紫外光化学合成. 用Cu/NiO-V_2O_5/SiO_2催化剂, 在常压、空速300 h^{-1}、140 ℃和125 W紫外灯辐照的情况下, CH_3OH的转化率为14.2%, 碳酸二甲酯的选择性可达89.9 %.

关键词 光催化 复合半导体 二氧化碳 甲醇 碳酸二甲酯

分类号

Study on Photo-catalytic Synthesis of Dimethyl Carbonate from CO_2 and CH_3OH over Cu/NiO-V_2O_5/SiO_2 Catalyst

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Abstract NiO-V_2O_5/SiO_2 and Cu/NiO-V_2O_5/SiO_2 were prepared by surface reaction modification method and isometric impregnation method, on which photo-stimulated surface reaction ability of synthesis of dimethyl carbonate (DMC) from CO_2 and CH_3OH were studied. TPR, XRD, UV-Vis DRS, IR and TPD-MS techniques were used to study the structure, light adsorption ability and chemisorption abilities of such catalysts. The results showed that Ni^{2+}—O—V^{5+} bond was formed on the surface of catalyst after NiO and V_2O_5 were coupled, and NiO and V_2O_5 on the surface of support could act with each other. NiO promoted the dispersion of V_2O_5 on the surface of silica, which effectively prevents V_2O_5 from aggregation, and the addition of Cu and NiO could expand the light-responding scope of photo catalyst. There were multiple active adsorption sites on the surface of catalyst, and the effective chemisorptions of CO_2 and methanol on the catalyst greatly promoted the photochemical synthesis of DMC even at lower temperature. Under the condition of normal pressure, space rate 300 h^{-1}, 140 ℃ and 125 W UV irradiation, the conversion of CH_3OH was up to 14.2% with the DMC selectivity of 89.9% over Cu/NiO-V_2O_5/SiO_2 catalyst.

Key words photo-catalytic reaction coupled semiconductor carbon dioxide methanol dimethyl carbonate

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