

工程热物理

TiO₂负载的二元金属氧化物催化剂低温NH₃选择性还原NO_x的研究

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摘要: 在TiO₂负载的锰氧化物(MnO_x/TiO₂)中引入第2种组分, 制成二元金属氧化物(MnO_x-A/TiO₂)催化剂, A分别为Fe₂O₃、WO₃、MoO₃、Cr₂O₃, 试验研究低温催化活性、N₂选择性及抗SO₂毒性。结果表明, 低温催化活性从高到低依次为: Mn-W/TiO₂>Mn-Fe/TiO₂>Mn-Cr/TiO₂>Mn-Mo/TiO₂; N₂选择性: Mn-Fe/TiO₂>Mn-W/TiO₂>Mn-Mo/TiO₂>Mn-Cr/TiO₂, Mn-Fe/TiO₂和Mn-W/TiO₂保持了较高低温催化活性的同时提高了N₂选择性。当反应气中含有*j*(SO₂)=0.01%和*j*(H₂O)=6%, 空速为12 600 h⁻¹、120 ℃、8 h后NO_x转化率Mn-W/TiO₂、Mn-Fe/TiO₂、Mn-Mo/TiO₂分别保持在98.5%、95.8%及94.2%。由此得出, WO₃、Fe₂O₃为MnO_x有效的助催化剂, 可大大提高MnO_x/TiO₂的选择性和抗SO₂毒性的能力。傅里叶变换红外光谱显示, 与Fe₂O₃不同, WO₃也提供了部分Lewis酸活性点, 说明在有低浓度SO₂存在下, Mn-W/TiO₂显示了极好的低温NH₃选择性还原NO_x的催化活性。

关键词: NH₃选择性催化还原NO 低温选择性催化还原 二元金属氧化物 傅里叶变换红外光谱 氨程序升温脱附

Binary Metal Oxides Supported on TiO₂ for Low-temperature Selective Catalytic Reduction of NO_x with NH₃

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Abstract: The manganese-based binary metal oxides supported on titanium dioxide (MnO_x-A/TiO₂) were prepared, where A means Fe₂O₃, WO₃, MoO₃ and Cr₂O₃. Their catalytic activity, N₂ selectivity and SO₂ poisonous tolerance were investigated. The catalytic performance at low temperature decreased in the following order: Mn-W/TiO₂>Mn-Fe/TiO₂> Mn-Cr/TiO₂>Mn-Mo/TiO₂, while N₂ selectivity: Mn-Fe/TiO₂>Mn-W/TiO₂>Mn-Mo/TiO₂>Mn-Cr/TiO₂. In presence of 0.01% SO₂ and 6% H₂O, the NO_x conversion of Mn-W/TiO₂, Mn-Fe/TiO₂, Mn-Mo/TiO₂ maintained 98.5%, 95.8% and 94.2% respectively after 8 h at 120 ℃ at GHSV 12 600 h⁻¹. As effective promoters, WO₃ and Fe₂O₃ can increase N₂ selectivity and the resistance to SO₂ of MnO_x/TiO₂ significantly. The Fourier transform infrared spectrum (FT-IR) spectra of NH₃ showed that unlike Fe₂O₃, WO₃ also provides part of Lewis acid sites. In presence of low concentration of SO₂, Mn-W/TiO₂ exhibited excellent catalytic performance for low temperature selective catalytic reduction of NO with NH₃.

Keywords: selective catalytic reduction of NO with NH₃ low-temperature selective catalytic reduction binary metal oxides Fourier transform infrared spectrum NH₃ temperature programmed desorption

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