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低温等离子体改性对Fe_2O_3/ACF低温选择性催化还原NO的影响

Effect of Fe_2O_3/ACF catalysts modified by non-thermal plasma on the selective catalytic reduction of NO at low temperature

关键词： 氮氧化物 低温选择性催化还原(SCR) Fe_2O_3/ACF 低温等离子体改性

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摘要： 利用N_2低温等离子体对过量溶液浸渍法制备的Fe_2O_3/ACF(活性炭纤维)催化剂进行了改性,运用BET比表面积、扫描电子显微镜(SEM)、X射线衍射光谱(XRD)和傅立叶变换红外光谱(FT-IR)对催化剂进行表征.同时,对催化剂的NH_3选择性催化还原(SCR)NO的催化性能进行了研究.结果表明,活性组分最佳负载量的质量分数为10.3%;N_2等离子体改性最优改性电压为6kV,改性时间为3min;随着反应温度的升高,空白ACF上NO转化率先升高再下降,而催化剂上NO转化率呈上升趋势.在NO体积分数1000×10^{-6}、NH_3体积分数1000×10^{-6}、O_2体积分数5%、空速$10040h^{-1}$和反应温度240℃的条件下,催化剂3.7%Fe_2O_3/ACF和10.3%Fe_2O_3/ACF经N_2等离子体改性后,其NO转化率(相对于未改性的)分别提高了16.43%和6.84%.N_2等离子体改性催化剂提高了活性组分在ACF上的分散度,增加了ACF表面的含氮官能团,从而提高了催化剂的SCR低温活性.

Abstract: A series of Fe_2O_3/ACF (activated carbon fiber) catalysts were prepared by excess solution impregnation and then modified with a non-thermal N_2 plasma at atmospheric pressure in a self-made wire-plate dielectric barrier discharge (DBD) apparatus. The relationship between the catalytic performance and the structure of the Fe_2O_3/ACF catalysts was explored using BET surface area measurement,scanning electron microscopy (SEM),X-ray powder diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR). The catalytic activity for the selective catalytic reduction (SCR) of NO with NH_3 in O_2 at temperatures between 120℃ and 240℃ was studied. The optimal catalyst preparation conditions were active component (Fe_2O_3) loading of 10.3% followed by non-thermal N_2 plasma treatment at 6 kV for 3 min. The NO conversion on blank ACF initially increased between 120℃ and 150℃ and then decreased above 150℃,while the NO conversion on Fe_2O_3/ACF catalysts continued to increase. Under the reaction conditions of NO volume fraction 1000×10^{-6},NH_3 volume fraction 1000×10^{-6},O_2 5%,GHSV (gas hourly space velocity) =10040 h^{-1} and reaction temperature 240℃,the NO conversion on 3.7% and 10.3% Fe_2O_3/ACF modified with the N_2 plasma increased by 16.43% and 6.84%,respectively. After N_2 plasma treatment,the catalytic activity of Fe_2O_3/ACF was enhanced because of an increased number of nitrogen-containing functional groups on ACF and improved dispersion of the active component (Fe_2O_3).

Key words: nitrogen oxide low-temperature selective catalytic reduction (SCR) Fe_2O_3/ACF non-thermal plasma modification

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