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利用硫酸氧钒制备钒炭催化剂用于烟气脱硫

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Using vanadyl sulfate to prepare carbon-supported vanadium catalyst for flue gas desulfurization

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摘要 利用硫酸氧钒制备钒炭催化剂用于烟气脱硫。研究发现,负载在活性炭上的硫酸氧钒极易被氧化为五价钒硫酸盐,这些五价钒硫酸盐具有很高的氧化SO_2的活性,极大地促进了SO_2在活性炭上的脱除。而且,通过煅烧可以将五价钒硫酸盐分解为五价钒氧化物,最佳煅烧温度为500℃,由于煅烧后用于储存硫酸的微孔孔容增加,SO_2的吸附容量得到了进一步提高,由此表明,利用硫酸氧钒可以制备传统的V_2O_5/AC催化剂。为了获得完全氧化的钒物种,对煅烧后的催化剂进行了空气中预氧化,但由于含氧官能团的形成、炭载体的烧蚀以及钒的还原,预氧化不利于脱硫。此外,研究中得到初步证据证明脱硫过程中V_2O_5/AC催化剂中五价钒氧化物转变成了五价钒硫酸盐,结合五价钒硫酸盐所表现出的氧化SO_2的能力,推测SO_2在V_2O_5/AC上的脱除遵循以下机理:五价钒氧化物先转变为五价钒硫酸盐,后者催化氧化SO_2为硫酸。

关键词: V_2O_5/AC 脱硫 硫酸钒 催化作用 低温

Abstract: Vanadyl sulfate ($V^{IV}OSO_4$) was used to prepare carbon-supported vanadium catalyst for flue gas desulfurization. The $V^{IV}OSO_4$ impregnated on activated carbon (AC) was easily oxidized into vanadium(V) sulfate phase (possibly $V_2O_3(SO_4)_2$) in air, which exhibited high catalytic activity toward SO_2 oxidation, thus significantly enhancing SO_2 retention on AC. Furthermore, the vanadium(V) sulfate can be decomposed upon calcination in nitrogen with optimum temperature of 500 ℃ to form vanadium(V) oxide, further improving SO_2 retention mainly due to increase in micorpore volume suitable for sulfate storage and showing suitability of vanadyl sulfate to prepare traditional V_2O_5/AC catalyst. To obtain fully oxidized vanadium oxides, preoxidation was carried out on catalyst after calcination. However, due to ablation of carbon support, reduction of vanadium and/or formation of surface oxygen groups, the preoxidation was negative for SO_2 retention. Additionally, this paper provided preliminary evidence indicating transformation of vanadium(V) oxide in V_2O_5/AC into vanadium(V) sulfate during desulfurization. Combined with catalytic role of vanadium(V) sulfate for SO_2 oxidation, SO_2 removal on V_2O_5/AC likely followed a mechanism that the vanadium(V) oxide firstly transformed into vanadium(V) sulfate and the latter was then responsible for subsequent SO_2 oxidation into H_2SO_4.

Key words: V_2O_5/AC SO_2 removal vanadium(V) sulfate catalytic role low temperature

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