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研究论文

NaCl与Fe_2O_3混合物对SO_2的有效吸收

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摘要 采用DRIFTS和XPS等方法研究了SO_2在NaCl和α-Fe_2O_3混合物表面的复相反应, 并计算了反应的吸附常数. 结果表明, 反应生成物主要为硫酸盐、硫酸氢盐以及少量的亚硫酸(氢)盐; SO_2与NaCl和α-Fe_2O_3混合物的反应符合零级反应动力学规律; NaCl的含量对反应有影响, 随着混合物中NaCl含量的增加, BET吸附常数呈现先上升而后再下降的变化规律, 当NaCl的质量分数达到70%左右时, BET吸附常数达到最大(4.62×10^{-6}), 是纯α-Fe_2O_3(5.72×10^{-7})的8.08倍; 反应生成的$FeCl_2$-SO_3^-中间体作为SO_2的储存库, 促进了更多的硫酸盐生成.

关键词 矿尘与海盐混合物 红外漫反射 复相反应 吸附常数 硫酸盐

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DOI:

Internal Mixture of NaCl and Fe_2O_3 Serving as an Efficient Scavenger for Sulfur Dioxide

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Abstract Internal mixing of sea-salt and mineral dust is often observed in coastal regions and the adjacent marine boundary layer, but the influence on atmospheric chemistry is not well known. In this paper the investigation of the reaction of SO_2 on the surface of mixed particles composed of Fe_2O_3 and NaCl was made by means of DRIFTS and XPS and the corresponding reactive uptake coefficients were calculated. The main products were sulfate/bisulfate and the minor product was sulfite/bisulfite. It was shown that the reaction rates with SO_2 are correlated with zero order kinetis. The reactive uptake coefficient for SO_2 oxidation by O_2 was determined. Different proportions of NaCl resulted in distinct reaction abilities. With increasing the proportion of NaCl, the BET uptake coefficient increased at first and decreased afterwards. When NaCl accounted for 70% of the mixture, the BET uptake coefficient accounted to 4.62×10^{-6}, which is 8.07 times as much as that of pure α-Fe_2O_3(5.72×10^{-7}). The $FeCl_2$-SO_3^- formed and served as a temporal reservoir of sulfur species, which can be used to explain the experiment results. The mixture shows a significant capacity to scavenge SO_2, it is important to implicate the heterogeneous gas-to-particle conversion mechanism of atmospheric SO_2, reevaluate the impact involving mineral dust mixed with sea salt and the influence of the aerosol radiative forcing and the sulfate cooling effect.

Key words NaCl mixed with hematite; DRIFTS; Heterogeneous reaction; Uptake coefficient; Sulfate

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