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A deep insight into arsenic adsorption over γ -Al₂O₃ in the presence of SO₂/NO

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Abstract

Arsenic is easily evaporated during coal combustion, which not only raises serious environmental concerns but also results in the deactivation of catalyst in selective catalytic reduction (SCR) systems. It is a promising method to use sorbents for the capture of arsenic vapors (As₂O₃(g)) before As-containing flue gas entering SCR catalyst. However, arsenic has a strong affinity with sulfur in coal and SO₂ in the coal combustion flue gas strongly suppresses As₂O₃(g) capture by typical Ca/Fe-based sorbents. This study estimated the selective capture of As₂O₃(g) by γ -Al₂O₃ and the effects of SO₂ and NO on the arsenic adsorption were investigated. The results showed that As₂O₃(g) adsorption over γ -Al₂O₃ was effectively conducted at temperatures ranging from 300 to 400 °C. In the reacted γ -Al₂O₃, arsenic was predominantly in the form of As³⁺ through reactions with Al-O bonds and positive charged alumina ions. SO₂ was slightly adsorbed on γ -Al₂O₃, which had a limited effect on arsenic adsorption. The adsorption of SO₂ on γ -Al₂O₃ mainly occurred on the sites of hydroxyl groups (Al-OH) and few adsorbed SO₂ was bound with positive charged alumina ions. NO was catalytically oxidized by γ -Al₂O₃ and released as NO₂. Nevertheless, NO competed with As₂O₃(g) to adhere to positive charged alumina ions and strongly suppressed arsenic adsorption over γ -Al₂O₃. Fortunately, in the presence of SO₂, NO was mostly transformed into intermediate (-SO₃NO) at the sites of Al-OH on γ -Al₂O₃. As a result, the adverse effect of NO on the adsorption of As₂O₃(g) was weakened.

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Keywords: Arsenic adsorption; γ -Al₂O₃; Reaction sites; SO₂; NO

1. Introduction

Arsenic is widely spread in coal and predominantly transformed into vapor phase (As₂O₃(g), As³⁺) during coal combustion [1,2]. Arsenic vapors are likely to be enriched in fine particles through

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