INFLUENCE OF MgO LOADING ON THE STRUCTURE AND CATALYTIC PERFORMANCE OF Pd/γ-Al₂O₃, I.
EFFECT OF INTERACTION BETWEEN MgO AND γ-Al₂O₃
Caixia Qi, Tingfang Bai and Lidun An
Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000, China

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The influence of MgO dispersed on γ-Al₂O₃ in different amounts on the structure and performances of Pd/γ-Al₂O₃ catalysts has been studied by means of XRD, H₂-O₂ titration, BET and catalytic activity test for CO oxidation. It was found that introduction of MgO enhanced greatly the CO oxidation activity of the catalyst. It seems that the enhanced activity stems from the stronger interaction between MgO and γ-Al₂O₃ at a given temperature (e.g. 450 °C).

INTRODUCTION

Noble metal catalysts supported on heat-stable composite oxides are often used in eliminating organic solvent vapors and automobile exhaust gases. In recent years, the study of special properties of composite supports, e.g. interaction between the coated oxide and the substrate [1-2], their competitive adsorption for the active component [3-4], etc. has aroused great attention in particular in the system of (SiO₂, TiO₂, CeO₂, La₂O₃)/Al₂O₃(SiO₂) [5-6] and WO₃, MoO₃, etc. However, fewer data on the series of MgO/γ-Al₂O₃ have been reported. In this paper, by changing the content of MgO coated on γ-Al₂O₃,
we investigated the influence of MgO on the structure and catalytic performance of Pd/γ-Al₂O₃.

EXPERIMENTAL

The MgO/γ-Al₂O₃ composite supports were prepared by impregnation of Mg(NO₃)₂ solution, then calcined at 450 °C for 4 h. MgO contents (wt.%) were 0, 0.2, 0.8, 5, 10, 15, respectively. Supported Pd catalysts on MgO/γ-Al₂O₃ were prepared with double impregnation with Pd(NO₃)₂. EDTA was used as chelating agent for activation of the supports [8]. After drying at 120 °C for 2 h, calcination at 500 °C for 3 h and reduction with H₂ at 350 °C for 3 h, we obtained a series of palladium catalysts. The weight loading of Pd was determined by inductively coupled plasma emission spectroscopy, and was about 0.7 wt.% in all catalysts.

Specific surface area of MgO/γ-Al₂O₃ supports was measured by the simple BET method (N₂); XRD experiments were performed with a D/MAXRB 12KWX powder diffractometer; H₂-O₂ titration was used for determination of palladium dispersity on the catalysts.

CO oxidation as test reaction was carried out in a flow system consisting of a glass reactor with a thermocouple well at the center. The amount of catalyst used for each run was about 500 mg, with a particle size of 20-60 mesh. Composition of the feed gas was: CO:O₂:N₂ = 4:22:74 (v/v/v). Reaction product was analyzed by gas chromatography. Reaction activity was displayed with the lowest complete conversion temperature (simplified as LTCC) of CO under the reaction conditions. The lower the LTCC, the higher activity the catalyst has.

RESULTS AND DISCUSSION

Figure 1 shows the XRD spectra of a series of MgO/γ-Al₂O₃ supports. In comparison with the spectrum of γ-Al₂O₃, no difference was found when the MgO content was 0, 0.2, 0.8 and 5 wt.%, respectively. This indicates that MgO is well-dispersed on γ-Al₂O₃. However, when the MgO content was 10%, the diffraction peak of MgO crystals appeared (d=2.11), and the strength of