Hydrothermal Stability of Pd/ZrO_2 catalysts for methane combustion

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The Pd based catalysts are well known as the most active catalyst for methane combustion. The supported Pd catalysts are usually deactivated in the presence of water vapor regardless of various supports used, such as Al2O3, TiO2 and SnO2. However, zirconia supported Pd catalyst shows a hydrothermally stable activity in the presence of water vapor. The ZrO2 support was synthesized using the chemical precipitation technique and then calcined at different temperature from 700 to 1000 oC for 6 h. Pd/ZrO2 catalysts were prepared by impregnation method. To compare to the activity of Pd/ZrO2, Pd/γ-Al2O3 and Pd/Θ-Al2O3 catalysts were prepared. The XRD pattern of ZrO2 supports indicated only monoclinic phase. The Pd catalyst impregnated on ZrO2 support calcined at 900 oC exhibited the highest catalytic activity in the presence of water vapor. The activity of this catalyst was almost constant during the 15 h. However, the catalytic activity over Pd/γ-Al2O3 and Pd/Θ-Al2O3 continuously decreased. The catalytic activity of palladium strongly depended on the oxidation state of Pd and the PdO phase or Pd/PdO mixture was more active than metallic state. The catalysts were also characterized by XRD, N2-sorption, TEM, TPD and XPS.