

Synthesis of Mn-substituted Barium Hexaaluminates by Homogeneous Precipitation Method

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Recently, interest in environmental pollution is increasing globally, increasing regulations on emissions from various industries and homes. Due to stringent environmental regulations and low global energy shortages, the development of low efficiency low emissions furnace is needed. Catalyst combustion received considerable attention as an alternative to conventional flame combustion. Recent combustion technologies have been widely applied in various industrial processes. This process allows highly efficient combustion efficiency at temperatures of 1,100 °C to 1,400 °C, and it is a very attractive way to eliminate NO_x and CO emissions. Comparing conventional flame combustion and catalytic combustion, the catalytic combustion has advantages such as high efficiency, stable control, and suppression of NO_x emissions. To achieve high efficiency and low emissions of air pollutants, an excellent need for thermal efficiency and excellent heat quality is urgently needed.

The hexaaluminate was considered to be one of the most suitable materials for high temperature catalyst combustion due to high thermal stability and high activity. However, the activity in methane combustion was lower for unsubstituted BaAl₁₂O₁₉ matrix which may be used as catalysts supports in high temperature oxidation reaction. The active substituted ions, like Mn³⁺ or Fe³⁺, improve the reaction between methane and crystal oxygen by the redox cycles, which plays a key role for high combustion activity[1].

The aim of the present work was to synthesize Mn-substituted hexaaluminate

(BaMn_xAl_{12-x}O_{19-δ}, $x = 0-4$) by controlled homogeneous precipitation method and to evaluate their physicochemical performances and their activity in catalytic combustion of methane.

The thermal-gravimetric analysis (TGA), X-ray diffraction (XRD) and scanning electron microscope (SEM) were used for investigation the catalyst synthesis.

Soluble nitrate salts of the constituents and (NH₂)₂CO as a precipitating agent were used as raw materials. The hexaaluminate catalysts were prepared as follows. First, the mixed appropriate amounts of barium, aluminum and manganese nitrates solution was added into a well-stirred container with a urea solution at room temperature. The mixture solution would then convert to a hydrogel. The hydrogel was aged for 24 h. then filtered, washed with distilled water. The filter cake was put into an oven, dried at 110 °C for overnight in air, and converted to xerogel. Finally, the xerogel was calcined in a muffled furnace at 1200 °C for 2 h in air.

Al(OH)₃ and BaCO₃ prepared by homogeneous precipitation method have confirmed that they were formed Ba-hexaaluminate through firing process. Depending on the concentration of metallic salts and ageing times, the rates of formation of the Al(OH)₃ and Ba[Mn]CO₃ were changed. The formation rate of Al(OH)₃ was faster than that of Ba[Mn]CO₃. It was found that the percentage of metal salts formed by Mn-substituted hexaaluminate. Catalytic activity for methane combustion has been measured for Mn-substituted barium hexaaluminates.

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