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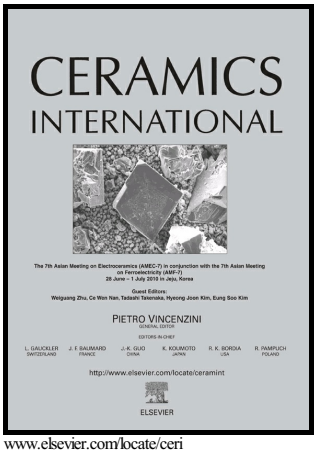

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Novel nonaqueous precipitation synthesis of alumina powders

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ABSTRACT

Alumina powders were prepared via a novel nonaqueous precipitation method with aluminum powders as aluminum source and anhydrous acetic acid as precipitant. The thermal decomposition and phase transformation of crystal precipitate and the influence of precipitate aging were investigated via TG-DTA-MS, XRD, TEM, BET, FE-SEM and performance tests of sintered bodies. The results show crystal precipitate $C_4H_7AlO_7$ transforms to amorphous Al_2O_3 at 300℃, and then to γ-Al_2O_3 at 950℃, and finally to α-Al_2O_3 at 1050℃. The particle size of α-Al_2O_3 prepared at 1100℃ is 50nm to 100nm with BET surface area of 25.98$m^2 \cdot g^{-1}$. FE-SEM morphology of sintered sample at 1400℃ shows excellent sinterability of the α-Al_2O_3 powders. Aging eliminates aggregation, and leads to highly homogenized and densified particles. It also affects the densification behaviour during sintering and further influences density, thermal expansion coefficient, flexural strength, volume resistivity and electric breakdown strength of sintered bodies

Keywords：alumina; powder; nonaqueous; precipitation method; crystal precipitate

1. Introduction

Alumina ceramic is one of the most widely used structural ceramic materials. It has attracted wide interests due to its properties of high melting point and hardness, excellent abrasion resistance, oxidation resistance and corrosion resistance. It has significant industrial applications in chemical, energy, automotive, defense, microelectronics, aerospace and other fields [1]. Alumina powders are also applied in many modern industries such as fine ceramic, metallurgy, electronics and optoelectronics [2~3]. Conventional methods for alumina powders preparation involve thermal decomposition of ammonium aluminum sulfate method [4], chlorine alkoxide method [5], Bayer method [6], spark discharge method [7], thermal decomposition of ammonium aluminum carbonate hydroxide (AACH) method [8], chemical vapor deposition (CVD) method [9~10], hydrolytic sol-gel method [11] , non-hydrolytic sol-gel method [12~13], microemulsion method [14], spray pyrolysis method [15], hydrothermal method [16], mechanochemical method [17], thermal plasma method [18], spray method [19], ball milling method [20], aqueous precipitation method [21~22]. Among these methods, precipitation method is a simple and short cycle chemical route. And it is widely used for ceramic powders preparation [23]. Meanwhile, numerous attempts have been reported aimed at preventing agglomeration by means of organic dispersants [24~25]. In this work, a novel strategy for alumina powders