Na-β Alumina Powder Processing by a Na_2CO_3 Precipitation Method

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Abstract. A Na_2CO_3 precipitation method to prepare powder of Na-β-Alumina is presented. Comparisons have been made with powder of the same composition obtained by two other methods: the traditional one and a slurry-solution method. After phase characterisation by X-ray, the powders were calcined at different temperatures. The resulting products were characterised by TGA, DSC and XRD analysis. Finally, density and ionic conductivity of sintered pellets were measured.

1. Introduction

For many years, compositions including β/β´´- alumina have shown a great interest as ionic conductors [1]. They are potential materials for batteries [1] and sensors[2].

There are two parent phases, designated β and β´´. The β phase has the theoretical formula $Na_2O{\cdot}11Al_2O_3$, or $NaAl_{11}O_{17}$ [3,4] and the β´´ phase has the formula $Na_2O{\cdot}5Al_2O_3$, or $NaAl_5O_8$ [5]. According to the Na_2O-Al_2O_3 phase diagram proposed by J. Fally et al. [6], β + β´´ coexist in a region corresponding to the formula $Na_2O{\cdot}nAl_2O_3$ ($5.33 \leq n \leq 8.5$).

In this paper, two compositions of beta-Al_2O_3, of n = 5.67 and 8.8, were studied. Here the word "beta" will be used as meaning β/β´´. To prepare the powders a Na_2CO_3 precipitation method was developed and compared with two other methods: the traditional and a slurry-solution one. The specimens were characterized by thermal analysis, X-ray diffraction, density, and conductivity measurements.

2. Experimental

2.1. Powder Mixing. The starting powders used here as percursors of beta-alumina were α-Al_2O_3 (0.3 μm) and Na_2CO_3 . Three methods to mix the starting powders were used separately. The traditional one is purely mechanical (Fig. 1). The powders were mixed with ethanol in a silica mortar and pestle mill during one hour. Then, they were dried under an infrared light. The second one, the slurry solution method, is similar to that described by J. Hodge [7] and consists in dispersing α-Al_2O_3 powder of a high surface area in an aqueous solution of Na_2CO_3 (Fig. 2). Finally, the Na_2CO_3 precipitation method described in

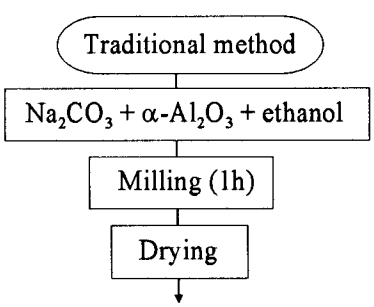

Fig. 1. Traditional method of powder mixing.

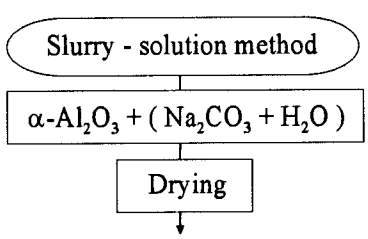

Fig. 2. Slurry-solution method of powder mixing.