Na-β Alumina Powder Processing by a Na₂CO₃ Precipitation Method

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Abstract. A Na₂CO₃ 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 Na₂O₁₁Al₂O₃, or NaAl₁₁O₁₇ [3,4] and the β'' phase has the formula Na₅O₅Al₂O₃, or NaAl₅O₈ [5]. According to the Na₂O-Al₂O₃ phase diagram proposed by J. Fally et al. [6], β + β'' coexist in a region corresponding to the formula Na₂OₙAl₂O₃ (5.33 ≤ n ≤ 8.5).

In this paper, two compositions of beta-Al₂O₃, 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 Na₂CO₃ 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 precursors of beta-alumina were α-Al₂O₃ (0.3 μm) and Na₂CO₃. 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-Al₂O₃ powder of a high surface area in an aqueous solution of Na₂CO₃ (Fig. 2). Finally, the Na₂CO₃ precipitation method described in