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ALTERNATIVE SYNTHESIS TECHNIQUES FOR BIMEVOX MATERIALS

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ABSTRACT

α-$Bi_4V_2O_{11}$ has been synthesized by the citrate technique. The thermal evolution of the material was followed by powder X-ray diffraction (XRD) and differential thermal analysis (DTA). The synthesis of the final material is obtained via the formation of the intermediate $BiVO_4$ phase. Complete disappearance of $BiVO_4$ and completion of the reaction can only be achieved after the sample is annealed at 750°C leading to high purity $Bi_4V_2O_{11}$ in the orthorhombic α-phase.

Key words: oxide conductor, BIMEVOX, synthesis

INTRODUCTION

Aurivillius phases have the general formula $Bi_2O_2(A_{n-1}B_nO_{3n+1})$ and can be described as layered structures, consisting of perovskite blocks sandwiched between fluorite-like $(Bi_2O_2)^{2+}$ sheets. Amongst these materials, $Bi_2VO_{5.5}$ is a one-layer Aurivillius phase presenting two main phase transitions that can be schematized as follows:

$$\alpha \underset{}{\overset{450\,C}{\rightleftharpoons}} \beta \overset{570\,C}{\rightleftharpoons} \gamma$$

Very high ion conductivity is observed in its high temperature γ form which is characterized by the distortion of the V-O octahedra and oxygen vacancy disorder that disappears on cooling[1].

It is also the parent structure of the so-called BIMEVOX materials (BI for Bismuth, ME for metal ion, V for Vanadium, and OX for oxide), where the Vanadium is partially replaced by other cations in order to stabilize the γ phase at lower temperature, but usually lead to a degradation of the ionic conductivity.

Alternative synthesis routes to the traditional solid-state reaction, particularly those inducing a reduction of the size of the particles, might be able to improve the physical properties of these materials[2]. Obtention of α and γ-$Bi_4V_2O_{11}$ have been reported by sol-gel[3] and co-precipitation technique[4], this last technique produces fully crystalline $Bi_4V_2O_{11}$ at 320°C.

Here we present the studies by X-ray diffraction (XRD) and differential thermal analysis (DTA) of $Bi_2VO_{5.5}$ prepared by the citrate (Pechini) method.