Accepted Manuscript

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PII: S0925-8388(17)31547-5

DOI: 10.1016/j.jallcom.2017.04.326

Reference: JALCOM 41730

To appear in: *Journal of Alloys and Compounds*

Received Date: 22 March 2017

Accepted Date: 30 April 2017

Please cite this article as: S. Hassairi, B. Louati, K. Guidara, Synthesis and characterisation of orthophosphate $KPbPO_4$ compound, *Journal of Alloys and Compounds* (2017), doi: 10.1016/j.jallcom.2017.04.326.

Synthesis and characterisation of orthophosphate $KPbPO_4$ compound

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Abstract

$KPbPO_4$ compound was prepared by the conventional solid-state method. The phase formation of the compound was checked by X-ray diffraction powder (XRD). The compound crystallizes in the orthorhombic system with the following crystal data: Pnma, Z = 4, (a = 7.450 (1) Å, b = 5.635 (7) Å, c = 9.958 (7) Å and V = 418.120 (1) $Å^3$). Arcanite structure was formed by regular PO_4^{3-}tetrahedra surrounding the Pb1|K1 and Pb2|K2 cations in nine and eight coordinations, respectively. Besides, the electrical data analysis of the impedance spectra was adapted to an equivalent circuit. Furthermore, the alternating current (AC) conductivity of grain contribution was interpreted by using the universal Jonscher's power law, and the frequency exponent n was studied for the compound′s conduction. The non-overlapping small polaron tunneling model (NSPT) was proposed as a closely good model to describe the conduction mechanism.

Keywords: $KPbPO_4$, equivalent circuit, conduction mechanism.

Introduction

Various research fields have been increasingly interested in using phosphate-based materials. Among the different classes of phosphates, orthophosphates, which were the first to be studied, are the most abundant and most stable. However, the development of fundamental research on materials, particularly the structure of several orthophosphates of the general formula $AMPO_4$ (A = alkali metal, M = divalent metal cation), has been studied for many years [1]. This makes it possible to upgrade phosphates as high-tech materials, taking into account numerous applications arising from their physicochemical properties, namely chemical stability, numerous possible formulations, great structural richness, etc. Some examples of potential applications in optics, catalysts, magnetic materials, fuel cells, bone surgery, sensors, laser materials, luminescence, ceramics, ionic conductors, etc [2, 3].