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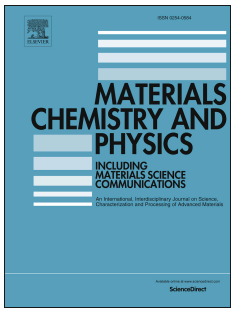

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AC Electrical conduction mechanisms and dielectrical studies of DD3 kaolin sintered at high temperature

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ABSTRACT

In this study, DD3 kaolin, as a raw material, was thermally treated at a temperature ranging from 1000°C to1600°C. The X-ray diffraction (XRD) patterns show the appearance of cristobalite and mullite phases at sintered temperature less than 1300°C. Moreover, they revealed the formation of mullite at a higher temperature (1600 °C). The surface of mullite sample (DD3 at 1600 ºC) is showed roughly with prismatic grains having an average size in the range of 32-42 nm. The FTIR spectrum is dominated by the stretching Si-O modes and Al-O at the wave number ranging from 443 and 1257 cm^{-1}.The dielectric and electrical properties were investigated in a wide frequency (0.1–10MHz) and at a temperature ranging from 0 and 200 °C. A strong dispersion of permittivity constants was observed at a low frequency, which can be attributed to interfacial Maxwell–Wagner–Sillar (MWS) relaxation. It is found that the ac conductivity depends on frequency and temperature with the Joncher power law $A(T)\ \omega^s$. Temperature analysis showed that the electron conductivity is controlled by both the small polaron tunneling (SPT) and the hopping correlated barrier (CBH) models.

Key words: DD3 kaolin, mullite, electrical and dielectric properties

1. Introduction

Clay minerals (also known as aluminosilicates) are naturally occurring materials and have well-defined layered structures, high adsorptive properties, and catalytic activities. These unique properties support using aluminosilicates in many applications as thermal protection for metals [1] as geopolymers and their uses [2] or as pigments after being doped [3].

Clay minerals are fine particles with diameters ranging from 2 to 5 μm. The internal structure of clays gives a specific characteristic of its chemical activity, where the small size and a specific crystal shape give the physical properties. The crystal lattice of clay is basically a