Frequency dependent dielectric properties of polycrystalline MgB_2

ABSTRACT

In this work, frequency dependent electrical properties of the polycrystalline MgB_2 synthesised at 650–850 °C were investigated. Dielectric permittivity (ε', ε"), dielectric loss (tan δ) and alternating current (AC) conductivity as a function of frequency (100 Hz to 10 MHz) were measured at room temperature. The X-ray diffraction (XRD) patterns, lattice properties and surface morphology of the prepared samples were analysed and correlated to the dielectric properties. It was found that all the samples showed negative permittivity as a result of negative capacitance indicating the metallic nature of these samples. For the samples sintered at higher temperature, they showed improved crystallinity as indicated by a smaller value of full width at half maximum for the XRD reflection peaks. These samples have more negative dielectric permittivity because of reduced defect density and better grain connectivity leading to a higher AC conductivity and dielectric loss. The single semi-arc observed in the complex admittance plot indicates the electrical behaviour is primarily due to the bulk response of the samples. The equivalent circuit modelled from the complex admittance plot suggests the presence of insulating barrier next to the conducting bulk in the samples. This may agree with the XRD data indicating the presence of insulating MgO in the MgB_2 samples.

Keyword: B. electron microscopy; B. x-ray methods; C. dielectric properties; D. MgB_2