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Intrinsic resistivity of sintered nickel manganite vs. powder activation time and density

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Introduction

Nickel manganite oxides, are very interesting ceramics widely used as negative temperature coefficient (NTC) mainly in electronics as elements of temperature control and compensation, time delay, voltage regulation, fan control etc.

Nickel manganite has an intermediate (partially inverse) cubic spinel structure. The values of cation inversion parameter is calculated (between 0.8 and 0.88).

Mechanism, responsible for conduction in nickel manganite, is described by a phonon-assisted electrons jump (so-called hopping) between Mn^{3+} and Mn^{4+} cations placed in octahedral sites.

In our earlier papers we have been investigated the influence of the time and temperature of sintering on thermal, optical and some electrical properties of this material [12,13,14].

The main purpose of this investigation is to show the unnegligible influence of mechanical activation of starting mixed oxides on electrical properties (direct current (DC) resistivity in our case) of originating nickel manganit.

Experimental

Mixtures of starting MnO, NiO and 0,5 wt % CoO and 0,5 wt % Fe_2O_3 powders was calcinated 1h at 1050°C, vibratory mill in an ultra-fast ball mill for 2h, and an average powder particle size of 0.9 mm was achieved

Mechanical activation was done by grinding in a continual regime in Fritsch Pulversette 5 planetary ball mill for 5,15,30,45 and 60 minutes

The grinding powders were unaxially pressed with 196 MPa into disc shape pellets 8 mm in diameter, and then sintered at 900, 1050 and 1200°C for 60 minutes.

The DC resistivity measurements was performed on impedance/gain phase analyzer HP 4194A, at room temperature, 50°C and 80°C

The coefficient of temperature sensitivity $B_{25/80}$ and acivation energies (E_a) for conduction was calculated

The crystalline structure of the nonactivated and activated samples were recorded using a XRP Difractometer Philips PW 1050, with Cu Kα radiation and a scans were taken with a step of 0.05°/s.

Results