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Temperature-dependent impedance spectroscopy of monovalent double tungstate oxide

M. Dhiaf[1], S. Megdiche Borchani[1, 2 *], M. Gargouri[1], K. Guidara[1], M. Megdiche[1]

[1]Laboratory of Spectroscopic and Optical Characterization of Materials (LaSCOM), Sfax Faculty of Science (FSS), BP 1171, Sfax University, 3000 Sfax- TUNISIA
[2]Higher Institute of Computing and Multimedia of Sfax (ISIMS), Sfax Technological Center, BP 242, Sakiet Ezzit, 3021 Sfax – TUNISIA

*: Corresponding authors:
Sameh Megdiche Borchani
E-mail: megdichesameh@yahoo.fr
Mariem Dhiaf
E-mail: mariemdhiaf@gmail.com

ABSTRACT

The sodium double tungstae $NaCr(WO_4)_2$ compound has been synthesized by the ceramic method and characterized by the X-ray diffraction (XRD) technique. The electrical conductivity and modulus characteristics of the system have been investigated in the temperature and the frequency range 592–670 K and 200 Hz–5 MHz respectively by means of impedance spectroscopy. The ac and dc conductivities were studied to explore the mechanism of conduction. Dielectric data were analyzed using complex electrical modulus M* at various temperatures. The non-overlapping small polaron (NSPT) model can explain the temperature dependence of the frequency exponent. The electrical conduction in sodium double tungstate $NaCr(WO_4)_2$ compound is presumably caused by the motion of Na^+ in the [010] direction tunnel. Conductivity measurements revealed that this compound is not a good ionic conductor probably because of the occupancy of sodium positions, which hinders the motion of the ions along the $(NaO_6)\infty$ columns.

Keywords: Impedance spectroscopy; Ac conductivity; Modulus formalism; Conduction mechanism; Double tungstate.

1. Introduction

Tungstate Oxides having general formula of the type A_2WO_4 and $A'A''(WO_4)_2$ (where A' is a monovalent metal and A'' is a trivalent metal (rare-earth)) crystallize in either a tetragonal