Synthesis and Frequency Dependent Dielectric Properties of Mn-Co co-doped NiO Nanoparticles

Mr. Ahmar Ali, King Fahd University of Petroleum and Minerals-KFUPM, KSA

Abstract

Nickel Oxide (NiO) nanoparticles (NPs)with doping of different concentration (maximum 6%) of Manganese (Mn) and cobalt (Co) were prepared by Composite hydroxide method (CHM). X-ray diffraction pattern confirms the formation of cubic structure of NiO NPs and no extra peak was observed. The average crystallite size was obtained from XRD and found to be 15 - 17.8 nm with the varying concentration of Mn and Co. The SEM images showed that the nanoparticles were almost spherical and agglomerated due to their magnetic nature. Fourier transform infrared spectroscopy analysis confirmed the existence of Mn and Co co-doped NiO which indicates the dispersion or substitution of the dopant material in the host material which were proved from XRD results. The higher value of the dielectric constant at low frequency may be due to the increased in the ion jump orientation effect and the increased space charge effect exhibited by NPs. The imaginary part of dielectric shows a decreasing trend with the increase in frequency because it is harder for electrons to align themselves along the direction of field at higher frequency. The both real and imaginary parts of dielectric constant showed an increasing trend at lower frequency and decreasing trend at the higher frequency in agreement with the Koop's theory. The dielectric loss is due to the flipping of dipoles and migration of charge carriers from grains to grain boundaries. Ac conductivity showed an increasing trend at higher frequency and decreasing at lower frequency due to the contribution of grain and grain boundaries. The sample S4 showed larger conductivity at high frequency regions which may be due to the presence of stronger small polaron hopping type of conduction of electron and as well as the larger crystallite size of these co-doped nanoparticles. These properties make them suitable for energy conversion device like solid oxide fuel cells.

Recent Publications (minimum 5)

1. Protity Saha, Ahmar Ali, S. M. Abu Nayem, Syed Shaheen Shah, Md. Abdul Aziz and A. J. Saleh Ahammad "Vanadium-based Cathodic Materials of Aqueous Zn-Ion Battery for Superior-Performance with Prolonged-Life Cycle

Photograph



Biography

Ahmar Ali' 23 born and raised in Islamabad, Pakistan graduated from International Islamic University Islamabad with bachelor's degree in physics, (2017-2021).

Ali was an active member of the university society of physics (SOP IIUI), where he coordinated many successful events. Ali was a visiting instructor at IQRA college of technology, IIUI. Additionally, Ali did an internship at Center for Advanced Electronics and Photovoltaic Engineering (CAEPE), International Islamic University Islamabad.

Currently (2022-2024) he is pursuing his master's degree in physics at King Fahd University of Petroleum and Minerals - KFUPM. His research Interests are energy storage materials/devices such as Supercapacitors, Batteries.

Email:
ahmaraliqureshi.99@gmail.com