Particle size-dependent electrical properties of nanocrystalline NiO

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Abstract:

Nickel oxide nanoparticles are formed by chemical precipitation and subsequent drying and calcinations at temperatures 523 K. Samples are characterized using X-ray diffraction and BET surface area measurements indicating the formation of a single NiO phase whose crystallite size increases with increasing calcination temperature. The electrical properties are examined by measuring DC and AC conductivities and dielectric properties as functions of temperature. Electrical conductivities first slightly increases with increasing particle size up to 7 10 nm and are about 8 orders of magnitude higher than that of NiO single crystals. Further increasing the particle size above 10 nm, leads to a monotonic decrease of conductivity. The data are discussed in view of variations of grain boundary as well as triple junction volume fractions as the particle size varies. At temperatures above D/2 (D is the Debye temperature), the conductivity is ascribed to a band-like conduction due to the large polaron. The activation energy of conduction was found to be minimal for the highly conducting samples of 7 10 nm, and gradually increases to ~0.5 eV with increasing the particle size above 10 nm. For T

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