Synthesis, Phase Characterization, and Properties of Chemical Solution-Deposited Nickel Manganite Thermistor Thin Films

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Source: JOURNAL OF THE AMERICAN CERAMIC SOCIETY Volume: 92 Issue: 3 Pages: 738-744 Published: MAR 2009

Abstract: Nickel manganite spinel thin films prepared by chemical solution deposition exhibit negative temperature coefficient of resistance (TCR) values between -3.3 and -4.5%/K. In contrast to bulk thermistors, dense films could be prepared completely within the spinel phase field. Thus, decomposition into the NiO phase and a Mn-rich spinel, which is problematic in bulk ceramics, is minimized in thin films. For films prepared outside of the single-phase field, phase separation cannot always be detected using X-ray diffraction. In such cases, transmission electron microscopy is useful in identifying decomposition. It is found that the lattice parameters for films with compositions ranging between Mn/(Mn+Ni)=0.14 and 0.77 are smaller than the values reported for nickel manganite spinels, suggesting cation deficiency. Single-phase spinel films are compared with single-phase bixbyite films synthesized between 630 º and 930 ºC. The bixbyite phase exhibits lower TCR and lower resistivity (TCR=-3.1 to -3.3%/K and resistivity values=400-1600 Ω.cm) compared with spinel (TCR=-3.6 to -4.1%/K and resistivity values=3500-21 000 Ω.cm). Composite films (achieved by controlling the pyrolysis to create a low local pO_2 during annealing) show intermediate values (TCR=-3.0 to -3.8%/K and resistivity values=470-6600 Ω.cm).