Formation, Sintering Behaviour and electrical properties of Spinel-Type CoxNiMn2-xO4 (0.2 ? x ? 1.2) Prepared by the Ethylene Glycol-Metal Nitrate Polymerised Complex Process

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Abstract

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Summary CoxNiMn2-x O4 (0.2 ≤ x ≤ 1.2) spinel-type powders were prepared by auto-combustion of ethylene glycol-metal nitrate polymerised gel precursors. A pure spinel-type phase, with no intermediate compounds, was attained from the burning of the polymerised gel precursor and subsequent calcining at 600 to 700 oC. The formation and the structural evolutions of the spinel-type phase have been studied by simultaneous thermogravimetric and differential thermal analysis (TG/DTA), X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, Brunauer-Emmett-Teller (BET), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). Powder characteristics such as particle size and specific surface areas of the calcined powders were dependent of the chemical compositions. In the same way, the crystalline structure of the synthesized spinel-type phases was strongly dependent of the Co content. Sintering of the CoxNiMn2-xO4 oxides has been studied by both the constant rate of heating (CRH) and the conventional ramp-and-holding methods. Density increased with the increasing of the Co content, and theoretically dense bodies (≥ 99.9 % of the theoretical density) with submicronic average grain sizes were obtained at a temperature as low as 1050 oC for 6 h in the case of the Co1.2NiMn0.8O4 composition. Above that temperature, a slow bloating phenomena as consequence of the evolution of oxygen gas with the corresponding decreasing in density in the sintered samples. The conductivity of spinel-dense samples (96 % Dth) also increased with the Co content. The sensitivity index, b 3000K, for all the spinel compositions allow us to assume a good technological thermistor performance for these ceramic materials.