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## Low-temperature synthesis of nanocrystalline NiCuZn ferrite and the effect of Cr substitution on its electrical properties

M.A. Gabal\*, Y.M. Al Angari

Chemistry Department, Faculty of Science, King Abdul Aziz University, Jeddah, Saudi Arabia

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### ABSTRACT

In this study, nano-sized ferrites of compositions  $(\text{Ni}_{0.6}\text{Cu}_{0.20}\text{Zn}_{0.20}\text{Fe}_{2-x}\text{Cr}_x\text{O}_4)$ , where  $x=0-1.0$ , were synthesized through nitrate–citrate auto-combustion method at relatively low temperature. XRD revealed the formation of nano-sized ferrite particles with cubic spinel structure. An exception was obtained for samples with Cr content  $\leq 0.2$ , where weak diffraction peaks attributed to the presence of CuO and  $\text{Fe}_2\text{O}_3$  were appeared. The average crystallite sizes are much dependent on the chromium content and were found to decrease with its increase. The lattice parameter ( $a$ ) slightly decreases with Cr substitution, which can be explained on the basis of the relative ionic radii of  $\text{Cr}^{3+}$  and  $\text{Fe}^{3+}$  ions. X-ray density was found also to decrease slightly with increase in chromium content, which indicates lower densification by the addition of Cr. FT-IR measurements show the characteristic ferrite bands. The Mössbauer spectra varied from Zeeman sextets to a relaxed doublet by increase in Cr content, which indicates a decrease in the hyperfine field at the octahedral site. Electrical property measurements revealed that  $\text{Cr}^{3+}$  ions do not participate in conduction process but limit the degree of  $\text{Fe}^{3+}-\text{O}^{2-}-\text{Fe}^{3+}$  conduction resulting in a decrease in the conductivity and increase in conduction activation energy.