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# Mössbauer studies of $\text{Cu}_{1-x}\text{Ni}_x\text{FeMnO}_4$ spinel ferrites

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## Abstract

Nickel copper ferromanganites  $\text{Cu}_{1-x}\text{Ni}_x\text{FeMnO}_4$  with the composition ( $0 \leq x \leq 1$ ) have been prepared using a ceramic technique. A single phase of these compounds was confirmed by X-ray powder diffraction measurements. Mössbauer spectra were recorded in 20–628 K temperature range. The spectra of all samples showed two well-resolved Zeeman patterns corresponding to A- and B-sites. At room temperature the hyperfine field increases with decreasing Cu concentration. The cation distribution obtained from analysis of Mössbauer spectra revealed a partially inverse spinel structure. The Curie temperature ( $T_C$ ) increased with the increase of the composition parameters ( $x$ ). The specific heat  $C_p$  for nucleus  $^{57}\text{Fe}$  was calculated from Mössbauer data for  $\text{Cu}_{0.5}\text{Ni}_{0.5}\text{FeMnO}_4$ , and  $\text{NiFeMnO}_4$ . The temperature dependence of the hyperfine parameters was studied, for these samples. The sublattice magnetization  $H(T)$  obeys the one-third power law in the range  $0.47 < T/T_C < 0.92$ .

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*Keywords:* Mössbauer spectroscopy; Spinel ferrites structure; The cation distribution; Specific heat; One-third power law

## 1. Introduction

Ferrites with spinel structure are the most widespread materials in radio engineering, automatics, and computer facilities. The change of synthesis temperature of ferrites results in cation redistribution of iron, which updates crystal properties, as macroscopic magnetic properties of ferrites. Copper ferrite among this extensive class of compounds has been investigated because of its

interesting crystallographic and electrical properties [1].

Studies on  $\text{NiFe}_2\text{O}_4$  showed that, the  $\text{Ni}^{2+}$  ion has a stronger octahedral site preference than  $\text{Fe}^{3+}$  in the inverse spinel  $\text{Fe}[\text{NiFe}]_2\text{O}_4$ . Several studies on  $\text{CuMn}_2\text{O}_4$  showed a cubic structure [2,3]. The cation distribution of  $\text{CuMn}_2\text{O}_4$  is determined by tendency of the  $\text{Cu}^{2+}$  ions to occupy B-site, and leading to an inverse structure. Moreover, the cation distribution of  $\text{Mn}^{2+}$  situated on A-sites,  $\text{Mn}^{4+}$  on B-sites and  $\text{Mn}^{3+}$  ions has to be taken into consideration on B-sites [4–6].

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