REVIEW OF RESEARCH
IMPACT FACTOR : 5.7631(UIF) UGC APPROVED JOURNAL NO. 48514 ISSN: 2249-894X
VOLUME - 8 | ISSUE - 2 | NOVEMBER - 2018

CURIE TEMPERATURE OF $Li_{0.35}Cd_xTi_xMn_{0.1}Fe_{2.55-2x}O_4$ FERRITE SYSTEM

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ABSTRACT

The ferrite samples $Li_{0.35}Cd_xTi_xMn_{0.1}Fe_{2.55-2x}O_4$ with (x =0.0, 0.1, 0.2, 0.3, 0.4 & 0.5) were synthesized by standard ceramic technique using pure metal oxides. The formation of single phase spinel structure of samples were confirmed by XRD patterns. The Curie temperature (Tc) of a ferromagnetic material can be measured by two ways. One the susceptibility can be measured as a function of temperature above the Curie temperature & second the magnetization can be measured as a function of temperature below the Curie temperature. Lithium ferrite belong to the soft spinel ferrite materials with a square hysteresis loop, high Curie temperature& saturation magnetization.

KEYWORDS:standard ceramic technique , Curie temperature.

INTRODUCTION:

A temperature at which a ferromagnetic or ferrimagnetic state of a material changes to paramagnetic state that temperature in a Curie temperature (Tc). It is also called as disordering temperature because the magnetic ordering is destroyed above this temperature. This temperature is the same as temperature at which susceptibility χ becomes infinite. Curie temperature (Tc) is one of the important property for the selection of ferrites for microwave applications. The Curie point is the measure of the strength of the magnetic order (the exchange energy) which is eventually destroyed by thermal randomization at Curie temperature. Our observations is that the Curie temperature decreases with addition of Cd^{2+} ions tends to decrease the number of A-B interactions. This may be due to A-O-B distance. Due to thermal vibrations, the magnetic A-B interactions in Ceramic material are broken at Curie temperature. Most of the investigators are explained the Curie temperatureon the basis of magnetic A-B interaction & domain structure in the ferrites. There are various methods to determiue the Curie temperatureof magnetic materials.

Lithium ferrites can be used in a lot of applications such as cathodes in rechargeable lithium batteries, high capacity batteries in electrochromic displays & used as strong oxidizing agent (1), (2), (3), (4).

EXPERIMENTAL

Curie temperature is one of the important properties of microwave ferrite. There are few experimental methods to determine Curie temperature. The general formula of ferrite system is $Li_{0.35}Cd_xTi_xMn_{0.1}Fe_{2.55-2x}O_4$ where x = 0.0, 0.1, 0.2, 0.3, 0.4 & 0.5. The AR grade of oxides Li_2Co_3, CdO, TiO_2, Mn_2O_3& Fe_2O_3 were used for the preparation of compositions in the above ferrite series. These oxides were weighted in the required mole proportions & mixed thoroughly in the agate mortar in acetone for about 2hr. The mixture was sieved. The mixture of each composition was preheated & were presintered at 300°C for 2 hours & finally sintered at 1000°C for 8 hours.

RESULTS AND DISCUSSION

All the sampler exhibit temperature invariance of the normalized susceptibility from room temperature upto Curie temperature, near the Curie temperature the susceptibility drops to zero abruptly and becomes zero at Curie temperature.

With the increase in temperature the permeability μi increases initially in a gradual way after words it increases rapidly near to Curie temperature (Tc). Near Curie temperature initial permeability drops sharply.

In dc resistivity, at certain temperature the slope of the graph logρ vs $10^3/T$ curve changes. It is established that the temperature at which the break occurs corresponds to the Curie point. The change in slope is attributed to the change in activation energy due to phase transition of the material from ferromagnetic to paramagnetic.

Table 1. Data on Curie temperature by d.c. resistivity, Susceptibility and permeability measurements and kTc values

x	Curie temperature T_c (^{0}C)			
	Resistivity d.c	Susceptibility	Permeability	KTc (e v)
0. 0	575	---	570	0.0491
0.1	425	427	430	0.0370
0.2	325	332	330	0.0284
0.3	250	245	240	0.0206
0.4	175	172	170	0.0146
0.5	125	130	125	0.0107

The Curie temperature of the ferrite samples $\mathbf{Li_{0.35}Cd_xTi_xMn_{0.1}Fe_{2.55-2x}O_4}$ with x = 0.0,0.1,0.2,0.3,0.4 and 0.5 obtained by dc resistivity , susceptibility and permeability measurements and KTc values are listed in Table 1. From Table 1. it is observed that the Curie temperature (Tc) decreases continuously and linearly with increasing x. This change with CdTi is dependent upon the cationic distribution and spacing in the crystal structure. The Curie temperature decreases with addition of CdTi ions which tends to decrease the number of A-B interactious. This may be due to A-O-B distance.

CONCLUSION:

Curie temperature is important parameter to know the use of ferrite material in high temperature. Knowledge of Curie temperature help in knowing the orderly state & the magnetic material from room temperature up to Curie temperature.

Above Curie temperature the ferrite obey Curie-Weiss law[5]. Due to thermal vibrations the magnetic AB interactions in spinal ferrites are broken at Curie temperature.

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