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INFLUENCE OF ZINC AND MANGANESE CO-SUBSTITUTION ON THE MAGNETIC PROPERTIES OF MAGNESIUM FERRITE.

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ABSTRACT:

The basic properties of spinel ferrites are sensitive to nature of substituent. Zn is a nonmagnetic and have strong tendency to occupy at tetrahedral (A) site whereas Mn^{4+} is magnetic in nature and prefers to occupy octahedral [B] site, Mg ions occupy both the tetrahedral (A) site and octahedral [B] site. Therefore, it will be interesting to investigate the magnetic properties of $MgZn_xMn_xFe_{2-2x}O_4$.

In the present work, we report our results on magnetic properties of Zn and Mn co-substituted magnesium ferrite.

KEYWORDS:Magnesium ferrite; Ceramic technique; X-ray diffraction

1. INTRODUCTION

The spinel ferrite represented by the formula MFe_2O_4 (where, M = Ni, Cu, Mn, Co, Fe, etc.) have a value for many technological applications due to their insulating property, high permeability, and moderate magnetization. The spinel ferrites are used in high frequency transformers, filters, isolators, automobiles, communication equipments, radio, television, and microwave and satellite communication [1].

In recent years, immense research efforts have been devoted to the fabrication and study of spinel ferrites. The basic electrical and magnetic properties of spinel ferrites have attracted many researchers. The electrical and magnetic properties of spinel ferrites depend on variety of factors which includes chemical compositions, method of preparation, preparative conditions, nature of cations and their distribution amongst tetrahedral (A) and octahedral [B] site [2].

2. Experimental details:

The samples of $MgZn_xMn_xFe_{2-2x}O_4$ spinel ferrite systems with varying x [x = 0.0, 0.1, 0.2, 0.3, 0.4, 0.5 and 0.6] were synthesized by double sintering ceramic method. A. R. grade oxides of magnesium, zinc, manganese and ferric were used for the preparation of $MgZn_xMn_xFe_{2-2x}O_4$ ferrite. All the synthesis powders were characterized by using X-ray diffraction (Philips X-ray diffractometer, Model PW3710) technique at room temperature.[3]

The magnetic properties were measured using pulse field technique provided by Magneta company. A.C. susceptibility measurements were carried out using double coil setup in the temperature range 300-800K.

3. RESULTS AND DISCUSSION

Magnetization:

The magnetic properties like saturation magnetization (M_s), remanant magnetization (M_r), coerecivity (H_c) and others are investigated using pulse field hysteresis loop technique.

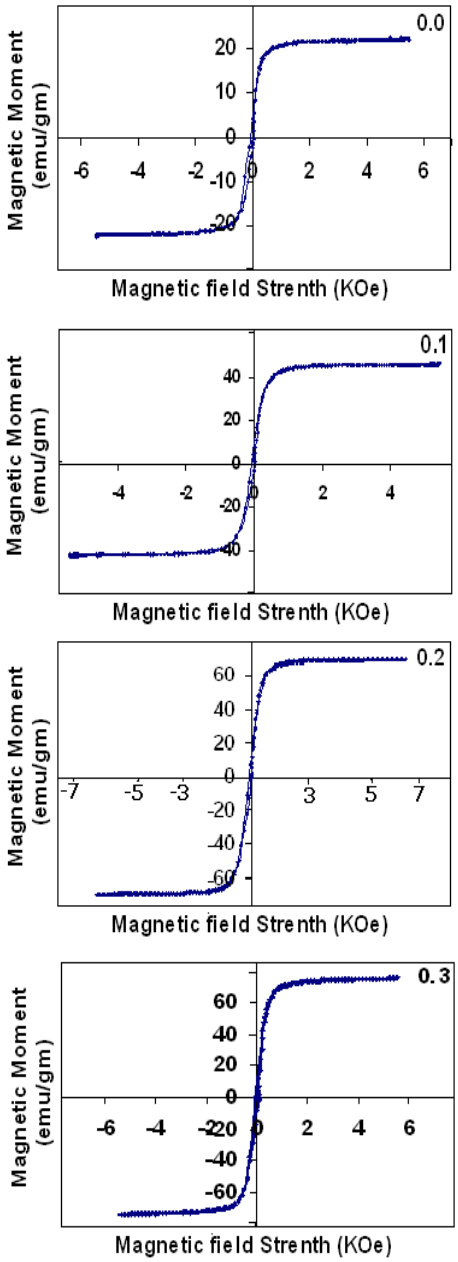

Fig1: *Variation magnetic field strength with magnetic moments for the system $MgZn_xMn_xFe_{2-2x}O_4$ for x = 0.0, 0.1, 0.2, 0.3*

Fig1.represents the M-H plots for all the compositions x. All the samples of the series $MgZn_xMn_xFe_{2-2x}O_4$ exhibit typical hysteresis curve showing ferrimagnetic behaviour of the samples. These M-H plots are used to obtain the values of coercivity, remanant magnetizations etc. and the values of these magnetic parameter[4].

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The magnetic moments of A and B sites are calculated by taking the ionic magnetic moments of Fe^{3+}, Mn^{4+}, Zn^{2+}, Mg^{2+} as $5\mu_B$, $4\mu_B$, $0\mu_B$, $0\mu_B$ respectively. Using cation distribution formula the values of Neel's magnetic moments are calculated.The observed and calculated magnetic moment agrees close to each other for x = 0.0 to x = 0.3. For x>0.3, it differ from each other indicating the existence of canted spin structure at octahedral B site.[5]

Table 1 Magnetization parameters of the system $MgZn_xMn_xFe_{2-2x}O_4$.

Comp. x	Magnetization parameter		
	Mr (emu/gm)	Ms (emu/gm)	Hc (Oe)
0.0	4.24	22.50	58.48
0.1	1.62	45.93	2.34
0.2	0.19	70.01	11.18
0.3	27.31	76.12	42.83
0.4	0.75	75.29	6.93
0.5	12.76	52.90	33.23
0.6	0.01	13.08	6.72

The magnetic properties like saturation magnetization (M_s), remanant magnetization (M_r), coerecivity (H_c) and others are investigated using pulse field hysteresis loop technique. [6]

Table 2.Measurement of Curie temperature by different methods of the system $MgZn_xMn_xFe_{2-2x}O_4$.

	A.C Susceptibility	**D.C. Resistivity**	**Loria technique**
0.0	683	703	676
0.1	673	683	663
0.2	652	669	641
0.3	641	651	625
0.4	619	628	603
0.5	574	605	592
0.6	542	568	572

The Curie temperature was also determined using Loria technique. The values of Curie temperature obtained by Loria technique are nearly in good agreement with the values of Curie temperature deduced from susceptibility .

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The decrease in Curie temperature with increase in zinc ion concentration 'x' is related to decrease in magnetic linkages associated with tetrahedral (A) and octahedral [B] site.

4. CONCLUSIONS

- The saturation magnetization M_s initially increases and then decreases with Zn, Mn concentration 'x'.
- Curie temperature decreases with increase in Zn, Mn concentration 'x'.

REFERENCES

1. Saw Mya Ni, Kay Thi Lwin, Proceedings of World Academy of Science Engineering and Technology, 36 (2008) 150.
2. K. B. Modi, H. H. Joshi, R. G. Kulkarni, J. Mater. Sci. 31 (1996) 01.
3. K. P. Thummer, H. H. Joshi, R. G. Kulkarni, J. Mater. Sci. Lett. 18 (1999) 1529.
4. S. L. Snoek, "New Development in ferromagnetic material".Elsevier Publishing Co. New York, Amsterdam (1947).
5. S. S. Shinde and K. M. Jadhav, Mater. Lett. 37 (1998) 63.
6. Santosh S. Jadhav, Sagar E. Shirsath, B. G. Toksha, D. R. Shengule, K. M. Jadhav,J. Opto. and Adv. Mater. 10 (2008) 2644.