www.vishwabharati.in ISSN 2320-6263

RESEARCH ARENA

A MULTI-DISCIPLINARY INTERNATIONAL REFEREED RESEARCH JOURNAL

Vol 5 • Issue 12 • March 2018

UGC APPROVED JOURNAL NO. 64395

VISHWABHARATI
RESEARCH CENTRE

VISHWABHARATI

RESEARCH ARENA
ISSN 2320-6263
Vol 5. Issue 12. March 2018.
http://www.vishwabharati.in

CONTENTS

"Lucid Moments": Identity Crisis
Subhash V. Shelake
7 - 11
अंतिम दशक की कहानियों में चित्रित पारिवारिक जीवन
रामलिंगा रेड्डी
12 - 16
Caste System and Castism in India
Rajashekhar Mavinamar
17 - 23
Democracy: its Essentials, its Defects and its Future in India
Anand C. Nadavinamani
22 - 32
God's Existence and Folk Language in Basaveshwar's Vachanas
Subhash Bhoger
33 - 38
Effect of Yogasana on Cognitive Variables of School Children
Geeta Rajaput & D.M. Jyoti
39 - 46
Apartheid Regime, Censorship and Theories of Writing in Coetzee
Rajeeva Poorna Chandra
47 - 59
जागतिकीकरणाचे भारतीय शिक्षणपध्दतीवर होणारे परिणाम
प्रा. शरद शंकर गायकवाड
60 - 64

Seasonal Variation in Physico-Chemical Parameters and Diversity in the Flora and Fauna of the Bori River in Osmanabad District (MS)
S.S. Baad
65 - 68
श्री. गणेशोत्सव काळातील कोल्हापूर शहराच्या विविध भागातील ध्वनी पातळी
विष्णू काकासाहेब सोनवणे
69 - 77
Michele Roberts: Vision Of Writing
Z. Z. Khan
78 - 81
Gallows View as a Detective Novel
Ranjit Annapa Bhadavankar
82 - 88
Challenges to New Panchayat Raj Institution: Grampanchayat and Women Sarpanch
Aruna Sane (Khamkar)
89 - 97
The Early Novels of V.S Naipaul: A Thematic Study
Mrinal Anand
98 - 108
Physical Education Emotional Intelligence and Achievement Motivation among Valley Ball Players and Its Effect of the Performance
Basavanneppa B. Kabadagi & Dr. A.G. Bujurke
109 - 116
Locus of Control and Achievement Motivation among Basket Ball Players and Its Effect on the Performances
Santosh B. Rajput & Dr. Md. Sayeeduddin
117 - 134
मृदुला गर्ग की कहानियों में राजनीतिक चित्रण
श्रीमती. राजू एस. बागलकोट
135 - 139
Antiviral Activity of Indole Analogues Against Chikungunya Virus
Mahalankar Prasad Panditrao, Bhalchandra Chate, Chandrashekhar Malba & Vijaykumar More
140 - 145

A Study on the Impact of Merger Announcement on Shareholders' Wealth in India: A Case Study of Sun Pharmaceutical Industries Ltd.
Vilas S. Bagade
146 - 154
Relationship between Emotional Quotient and Job Involvement in Women Empoyees
Shrinivas RD
155 - 166
Sickness in Indian Industry: An Empirical Analysis
I.S. Shivasharanar
167 - 175
Banking in India: Changing Scenario
Irayya S. Mathapati
176 - 183
The Magnetic Properties of Ferrite Materials: An Overview
Rohini Manikrao Mahindrakar
184 - 189

VISHWABHARATI
RESEARCH CENTRE

VISHWABHARATI

RESEARCH ARENA
ISSN 2320-6263
Vol 5. Issue 12. March 2018. pp. 184-189
Paper received: 19 March 2018.
Paper accepted: 28 March 2018.

The Magnetic Properties of Ferrite Materials: An Overview

Rohini Manikrao Mahindrakar

Abstract:

Magnetic material exhibits different kind of magnetic ordering depending upon spin orientation. The magnetic behavior is caused by spinning of electrons of 'd' orbital about their own axis gives rise to spin magnetic moments. The motion of electron in the orbit around the nucleus results in orbital magnetic moments. In case of transition element, these orbital magnetic moments get quenched by crystalline electrical field. The different magnetic behavior observed is due to different contribution of electron spin. On the basis of electron spin magnetism is classified as diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism and ferromagnetism. In this present paper we discuss about magnetic properties of ferromagnetic material such as ferrites.

1.1 Introduction:

Ferrites remain the best magnetic material and cannot be replaced by any other magnetic element because they are

Rohini Manikrao Mahindrakar: Dept. of Physics, A.S.C. College, Naldurg, Tuljapur, Osmanabad (MS) India.

inexpensive, more stable and have a wide range of technological applications in transformer cores, high quality filters. radio wave circuits and operating devices [The ferrites have many applications in different branches due to their high electrical resitivity and low eddy current losses. It has been reported that Mn-Zn [1] and Ni-Zn ferrites provides firmly magnetic material useful for TV and Radio sets as well as mobile telephone. Ni-Zn ferrites have been found to be most versatile for their large number of applications. With the use of small and compact power supplies for computers, microprocessor and VCRs has been an increasing demand for power ferrites with increased switching frequencies and material performances [2]. There have been large number of studies on the spinel systems, which are diluted with various non-magnetic impurities of different orders [3,4].

1.2 Application of Ferrites:

Ferrites have vast applications from microwave to radio frequencies. Soft ferrites are well known dielectric material and are very useful in microwave applications. High quality filters, antenna rods, radio frequency circuit, transformer cores, read/ write heads for high-speed digital tapes and sensors [5]. Following are the applications of soft ferrites.

1) Magnetic Sensors: They are used for temperature control and can be made using ferrite with sharp and definite Curie temperature. Position and rotational angle sensors have also been designed using ferrites.
2) Magnetic Shielding: A radar absorbing paint renders an aircraft or submarine invisible to radar.
3) Pollution Control: There are several Japanese installations which use precipitation of ferrite precursors to savage pollutant material such as mercury from waste streams. The ferrite produced subsequently can be separated magnetically along with pollutant.
4) Ferrites electrodes: Because of their high corrosion resistance, ferrites having the appropriate conductivities have been used as electrodes in applications such as chromium plating.

5) Entertainment ferrites: Ferrites are widely used in radio and television circuits. Typical applications include antenna, deflection Yokes, fly back transformer and SMPS transformers for power applications.

1.3 Magnetic Properties:

Magnetic properties depend upon metallurgical conditions of the material viz.

i) The size, shape and orientation of grains,

ii) The concentration and distribution of various crystal imperfections.

iii) The state of lattice regarding impurities and atomic arrangement in alloys.

iv) The distribution of cations over the tetrahedral and octahedral site.

Magnetic properties are divided into two groups; intrinsic (structure-insensitive) and extrinsic (structure-sensitive). Saturation magnetization and Curie temperature are the two prominent structure-insensitive properties. Structure sensitive properties are again divided in to two groups i.e. static and dynamic.

1.3.1 Intrinsic Properties:

a) Saturation Magnetization:

"The maximum attainable intensity of magnetization per unit volume is known as the saturation magnetization of material." It is denoted by Ms(T), signifying that it varies as a function of temperature. As $T \rightarrow 0K$, $Ms(T) \rightarrow M0$, which is called absolute saturation magnetization.

The magnetization is a powerful tool to study the different parameter such as domain wall, anisotropy, magnetic hardness of material, magnetic ordering etc. When the magnetic field is applied to the ferromagnetic material, the magnetization may vary from zero to saturation value. This behaviour is expressed by Weiss [7].

According to him each domain is spontaneously magnetized in the direction of field; magnetization may vary from one domain to another domain. In general, specimen consists of many domains. The magnetic moment of specimen is a vector sum of magnetic moment of each domain. As a result the magnetization moment per unit volume may have value between zeros to saturation.

b) Curie Temperature:

All ferromagnetic materials exhibit a characteristic temperature known as the Curie temperature Tc. This is the critical temperature at which thermal energy is just enough to destroy the spontaneous magnetization. Thus, the Curie temperature marks the transition point at which a ferrimagnets is converted into paramagnet upon heating.

1.3.2 Extrinsic Properties:

1.3.2.1 Static Properties:

i) Magnetic Induction:

A vector that specifies the magnetite and direction of the magnetic field at a point. It is equal to the magnetic flux through a unit area of a magnetic field in a direction perpendicular to the direction of the magnetic force. The performance of a component of device depends on the magnetization of the ferromagnetic material involved induction, rather than magnetization is used to assess the performance. This is so because of the definition of induction, $B = \mu 0(H+M)$ has made it inherently structure sensitive property through the $\mu 0$ and H term.

ii) Permeability:

It is the ability of a magnetic material to conduct magnetic flux through it or it is the ratio of magnetic induction (B) to magnetic field (H)

1) Initial Permeability (μi): The limiting value approached by normal permeability when H is reduced to zero.
2) Maximum Permeability μmax: The largest value of normal permeability obtained from a (B-H) curve.

3) Intermediate Permeability: (μ_δ) is equal to $B\delta / H\delta$, where $H\delta$ is an alternating field in addition to a constant biasing field and $B\delta$ is the alternating induction caused by $H\delta$.
4) Differential permeability (μd) is equal to dB/dH and is simply the slope of B-H curve at each point.

iii) Hysteresis Loop and Energy Loss:

The word hysteresis has its origin in Greek word 'hysterein' which means "to lag behind." In B-H curve B lags behind H and thus the closed B-H curve is called hysteresis loop. The area enclosed by hysteresis loop represents an energy given by Wb = ∫H.dB. This magnetic energy is converted into heat, which dissipated into the lattice immediately upon generation and it is permanently lost. Thus, Wb is called the hysteresis loss with unit Joule per m3 per cycle. Soft magnetic materials have undesirable hysteresis loss.

iv) Coercive Force and Coercivity:

Hysteresis loop shows a characteristic field known as the coercive force Hc and a characteristic induction known as remanance (Br). The material with low coercive force i.e. less than 400A-m-1 (5Oe) are definitely considered as soft magnetic material and those material having Hc values greater than 8000A-m-1 (100 Oe) are called as hard magnetic materials. The lowest coercivity ever recorded is approximately 0.4Am-1(0.005Oe).

v) Remanance or Retentivity:

It is the ability of a material to hold its magnetism after the magnetizing force has been removed. Materials having high retentivity make good permanent magnets.

1.3.2.2 Dynamic Properties:

I) ***Eddy Current and Associated Energy Losses:*** This property is of great importance in the application of soft magnetic metals and alloys. When an alternating field is applied to magnetize a ferromagnetic body, an electromagnetic force (e.m.f.) is generated in the body. If the material having good conduction with metal and alloys, the induced e.m.f is produced, resulting in appreciable amount of currents in different regions, these currents are known as the eddy currents and their occurrence gives rise to energy loss (We) through Joule.

II) Motion and Resonance of Domain Walls: The resonance of Bloch walls is prominent phenomena detected in ferrites at high frequency. It plays an important role in the application of soft magnetic materials. It is found that, the eddy-current power loss is proportional to the square of the velocity of the domain walls. Thus, to minimize the loss, we must try to keep the wall velocity at the lowest possible value. On the other hand, some applications of ferrites at microwave frequency involve the resonance of domain walls.

III) Magneto-crystalline Anisotropy: It is known that because of exchange interaction, the spins on different ions align and this alignment is with respect to the crystal axis. Magneto-crystalline anisotropy results from the coupling between the electron spins and the orbital motion of the electron. Effect of an applied magnetic field on the spin moments depends on spin orientation with respect to the crystalline lattice.

IV) Magneto-striction: Magnetic body opposes to electric changes in the dimension due to magnetization and this effect is known as magneto-striction. Magnetization changes when length of body and magnetic field is changed.

References:

J.J. Snoek. New Development in Ferromagnetic material, *Elesevier, NewYork, 1974.*

B. Pavatheeswara Rao, P.S.V. Subba Rao, G.V.S. Murthy, K.H. Rao. *J.of Mag. Mag. Mater.268 (2004) 315- 320.*

S.M. Yunus , F.U.Ahmed , M.A.Asager, *J. Alloys Compounds 315 (2000)90.*

S.M. Yunus, H.S. Shim, M.A. Asager, F.U. Ahmed, A.K.M. Zakaria, *J. Magn. Magn. Mater. 232 (2001) 121.*

E.E. Riches. A review of materials and application in *J. Gordan (Ed), ferrites. Cook Mills and Books London. (1972) 17.*

P. Weiss *J. Phys. 6 (1907) 667.*