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Improvement Magnetic Properties of Nanocomposites UPE \ $ZnFe_2O_3$-MWCNT

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Abstract:

In this article, composites with a polymeric basis were prepared and developed with a ferrite zinc $ZnFe_2O_3$ material dyed with graphene that has the ability to absorb and attenuate by a weight ratio of (1-4) % of the base. The samples were formed by chemical blending and ultrasound technology to homogenize the mixture. The magnetic tests were performed using a VSM Vibrating Sample Magnetic, where a magnetic field was applied to the samples prepared at room temperature. The results showed a clear decrease in the compulsive field values, which was accompanied by a narrowing of the magnetization of saturation with an increase in the concentration of ferrite zinc nanomaterials supported by Multiple wall carbon nanotube MWCNT.

Keywords: Ferrite zinc, nanocomposite, UPE, VSM (Vibrating Sample Magnetic) and MWCNT.

Introduction:

It is an important class of magnetic oxide materials of a semiconductor nature and of great technological importance Thanks to their interesting properties, ferrite substances are usually ceramic compounds Ferromagnetism is derived from iron oxides such as hematite ($2O3$) or magnetite ($3O4$). As well as other metal oxides in different proportions depending on their types. It is like most ceramics They are hard and brittle [1]. The importance of the ferrite material to mankind was known for many centuries ago, in the early days The twelfth century, the Chinese used the stone magnet (Fe_3O_4) for compasses., [2], [3] The scientific use of ferrite began with the study of its structural and electrical properties and magnetism in the year 1930 AD, and since then many researchers have studied fright on wide range. Ferrite materials are unique magnetic materials that can be applied in all Fields almost always because they have a wide range of properties and have high electrical resistance

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Low eddy currents, low insulation losses, have high saturation magnetization, high permeability and permittivity Moderate, ferrite substances are used in transformer cores, antenna rods, and memory chips High-intensity magnetic recording media, doping, etc. ferrite material is very sensitive It is affected by the method of preparation, sintering conditions, amount of metal oxides, various additives and impurities Its constituents. 48 – 51. Ferrite are classified into three types on the basis of their crystal structure [4]. The first type Garnet It has a cubic crystal structure and is used in optical magnetic applications because it is transparent Visually. [5] Its chemical formula is ($R_3^3 + Fe^3_5 + O_1^2$), where R denotes ions. The two type Hard Ferrite, it has a hexagonal crystal structure and its chemical formula is $MFe_{12}O_{19}$, where M stands for dioecious ion The valence has a large ionic radius such as Ba^{2+}, Sr^{2+}, Pb^{2+}. Where the radii are Equal to the radius of oxygen ions and thus can replace them in the lattice. Includes. This mounting on the main axis (C) is easy to magnetize and the magnetization direction cannot be changed and the axis Secondary (a)] 6 –9]. The three type Soft Ferrite, its chemical formula is FCC ($M^2Fe_2^3O_4$) Where M is the divalent metal ions such as Co^{2+} , Ni^{2+} , Mn^{2+} , Mg^{2+}, Zn^{2+} , Cd^{2+} ,Cu^{2+} [10]. The dipoles of a given substance are affected by a set of forces, which are (internal forces) attraction and repulsion with Each other and (external forces) is a random force that matter acquires from thermal energy External, where these binaries are arranged in directions that may differ with each other to become their influence Outer zero. When applying an external magnetic field to that material, the field works on Directing the dipoles in its direction, so if the field succeeds in directing these dipoles, then these materials It is called magnetic materials, but if it does not succeed in directing it towards it, because there are materials that have forces External and internal are much larger than the applied field, as the resulting field remains equal to zero These materials are called non-magnetic materials. [11].

Preparation of Nanocomposites and Materials Used

In this paper, ferric zinc nanoparticles($ZnFe_2O_3$) were prepared using powder technology and denatured with 3% graphene Nano powder. The Nanocomposites were prepared using liquid mixing and ultrasound technology, where the unsaturated polyester resin(UPE) was mixed, which is a polymer that has a dense texture and a transparent color and fits within the thermally hardened material (thermostatic) where it is mixed with the prepared compound ($ZnFe_2O_3$/ MWCNT) at a ratio of (1 - 4%) as a weight percentage.

Theoretical Part;

Magnetism is represented by two fields, one of which is H, which means the strength of the magnetic field and is calculated from the current Electric generated by the magnetic field. The other one is B, which means the intensity of the magnetic field It is calculated from the force exerted on a wire carrying an electric current. And the relationship between these two areas is in Magnetic materials are. [12]

$B=H+4\pi M$……………(1) , Where M is the magnetization of the material

In magnetic applications, we are concerned with the amount of inductance produced by the application of an external magnetic field. In soft-wright materials, we notice that they reach

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saturation magnetism when a magnetic field is applied Small in intensity. In this case, according to equation (1), the value of H is very small compared to B. 4πM and B is basically equal to 4πM. As for permanent magnets, the H value can be 50%. Or more than the total B amount .

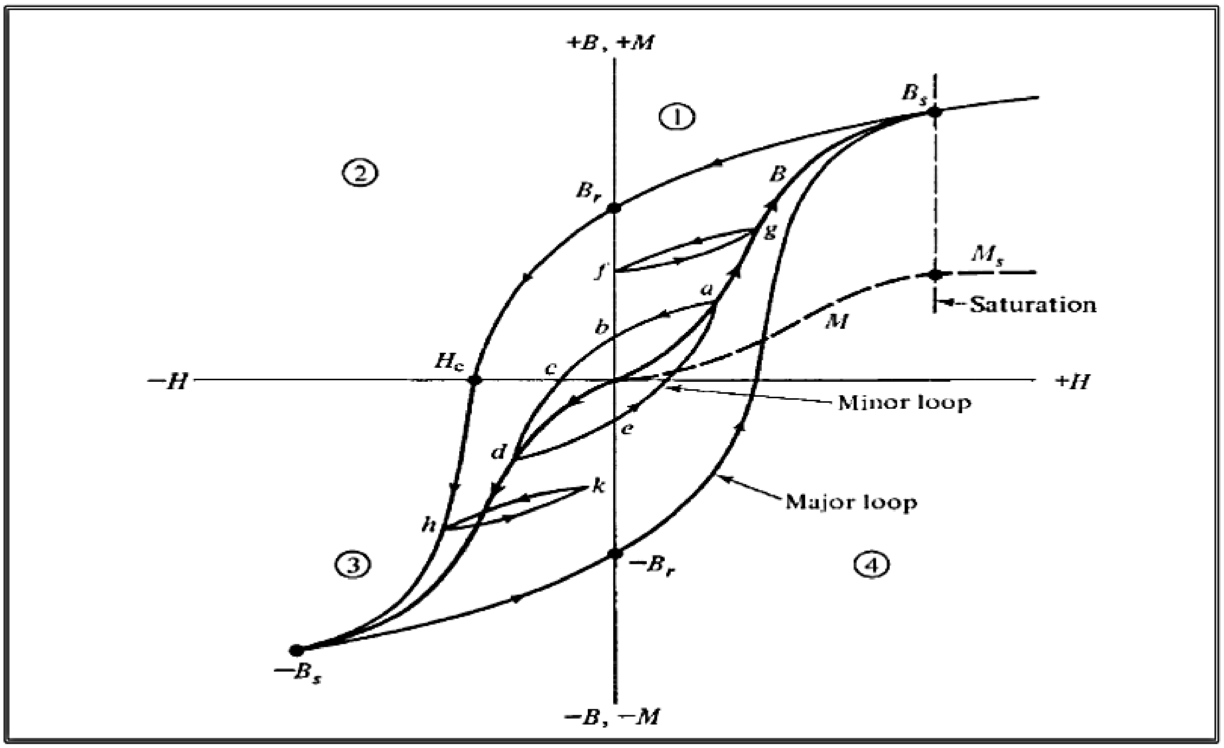

Fig. (1): A hysterical episode[9].

If we start with a non-magnetized sample B0 and increase the strength of the magnetized magnetic field H, then the induction It will increase non-linearly (in magnetic materials only) with increasing intensity as in Figure (1) At a certain value of H the material reaches a state of saturation (Bs, Ms) and when continuing with increasing intensity The field, the magnetization of M takes constant values and B continues to increase due to the increase of H that is formed Part of its formation according to equation 1 and that the curve from the state of non-magnetic material B_0 to represents natural induction. After the material reaches saturation, the field strength Bs in the saturation state is reduced Magnetic field to zero (where the original curve is not reproduced) as the value of the flux density decreases It is the residual magnetic field, and against the direction of the external magnetic field, in the direction Br to Bs from Compulsive field (Hc) opposite, the value of the flux density will reach zero at the intensity At Bs, by continuing to increase the field strength in the negative direction, the material reaches another saturation point Br, Bs to zero and then increasing it in the positive direction, the curve passes through points H decreasing Magnetic materials generally divide to form a ring called a regurgitation ring. [13] , [9]. The energy loss manifests itself in the form of heat,

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which raises the sample temperature Therefore, the materials that have a hysterizing ring with a small and narrow area are called spinel ferrite. Figure (2). Where transformer cores and rotating cores (Fig.2a)) are made of these materials, as shown in the for electric motors and generators. As for some applications that require the retention of magnetism Permanently, this requires materials with a hysteresis loop with a wide and wide area, as they are called such, and each of as shown in the figure 2b materials made of hard magnetic materials Permanent magnets, discs and magnetic tapes used in the entertainment and computer industry [14].

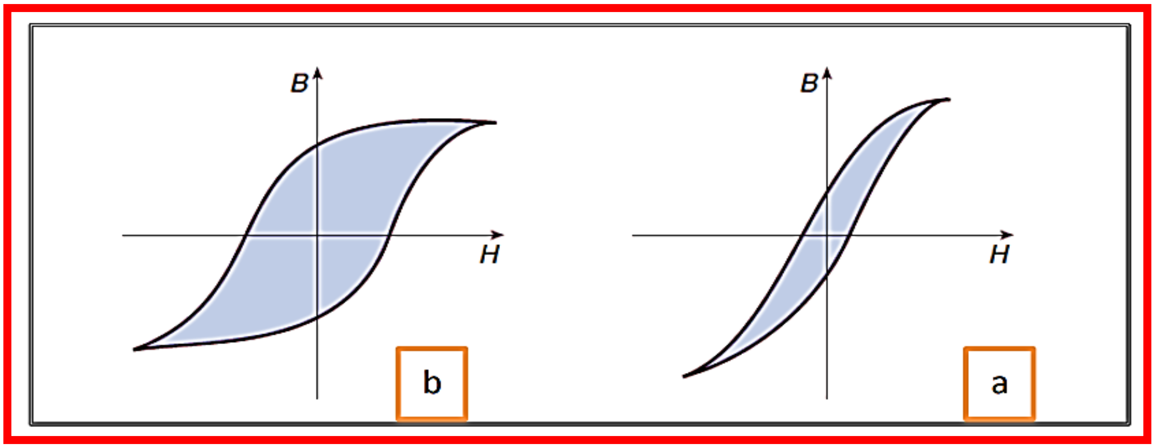

Fig.2: (a) Demonstrates the hysteresis loop of the soft gear and –(b) Demonstrates the hysteresis loop of hard material [13].

Result and Discussions

Magnetic Properties - VSM Examination Results

Magnetic properties such as hysterical loop, coercive force, and residual magnetism were measured using Cryogenic 14 Tesla VSM device shown in Figure (1) and table (1), the field strength ranged The applied magnetic field is between ± 10,000 Oe at room temperature. The prepared magnetic samples were recorded and determined using a VSM (Vibrating Sample Magnetometer) At room temperature, it is clear Fig. (2) Magnetization change as a function of the strength of the applied magnetic field Through the figure, the hysteresis curves can be observed and we can understand the magnetic behavior of the prepared samples In addition to providing information related to some magnetic factors such as saturation magnetization (Ms), magnetic moment (ɳB), coercive force (HC) and residual magnetism (Mr). The narrow curves through the figure indicate the properties of magnetic materials as soft. The different coefficients were estimated and summarized as in Table (1), as well as the change of compulsivity, magnetization of saturation and magnetic moment with respect to the change of the concentration factor in the samples. Where the magnetic moment ɳB was calculated using the relationship [13]:

$$\eta_B = \frac{Wm\ X\ Ms}{5585}$$

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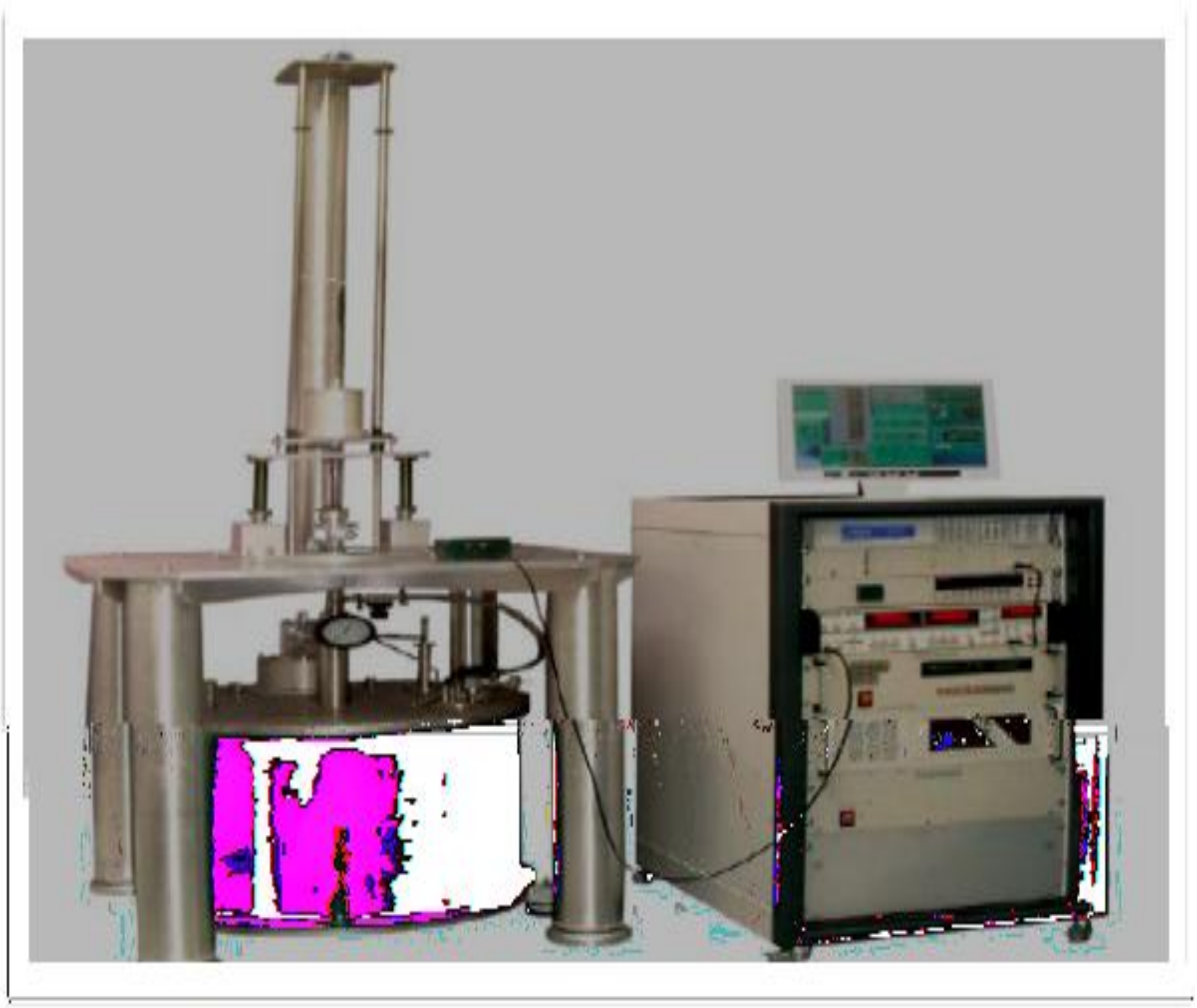
Where (Wm) represents the molecular weight of the compound, and (Ms) is the magnetization of saturation. The (VSM) examination of the prepared samples revealed tight hysteresis episodes as shown in Figure (2). The magnetic contrast constant can also be calculated through the following relationship [15]:

$$H_C = (0.96\ K) / M_S$$

Table 1: Magnetic Properties

K x 10^{-3} (emu.Oe.g^{-1})	**η_B**	**H_c (O_e)**	**M_r (emu/g)**	**M_s (emu/g)**	**Samples**
2.2020	0.028229	0.02943	0.114	0.71832	**1**
3.8852	0.012853	0.11404	0.1308	0.32706	**2**
1.3737	0.010357	0.05004	0.0668	0.26356	**3**
2.4943	0.003065	0.00307	0.00459	0.078	**4**
-0.68085	0.001416	-0.00225	0.00307	0.02905	**5**



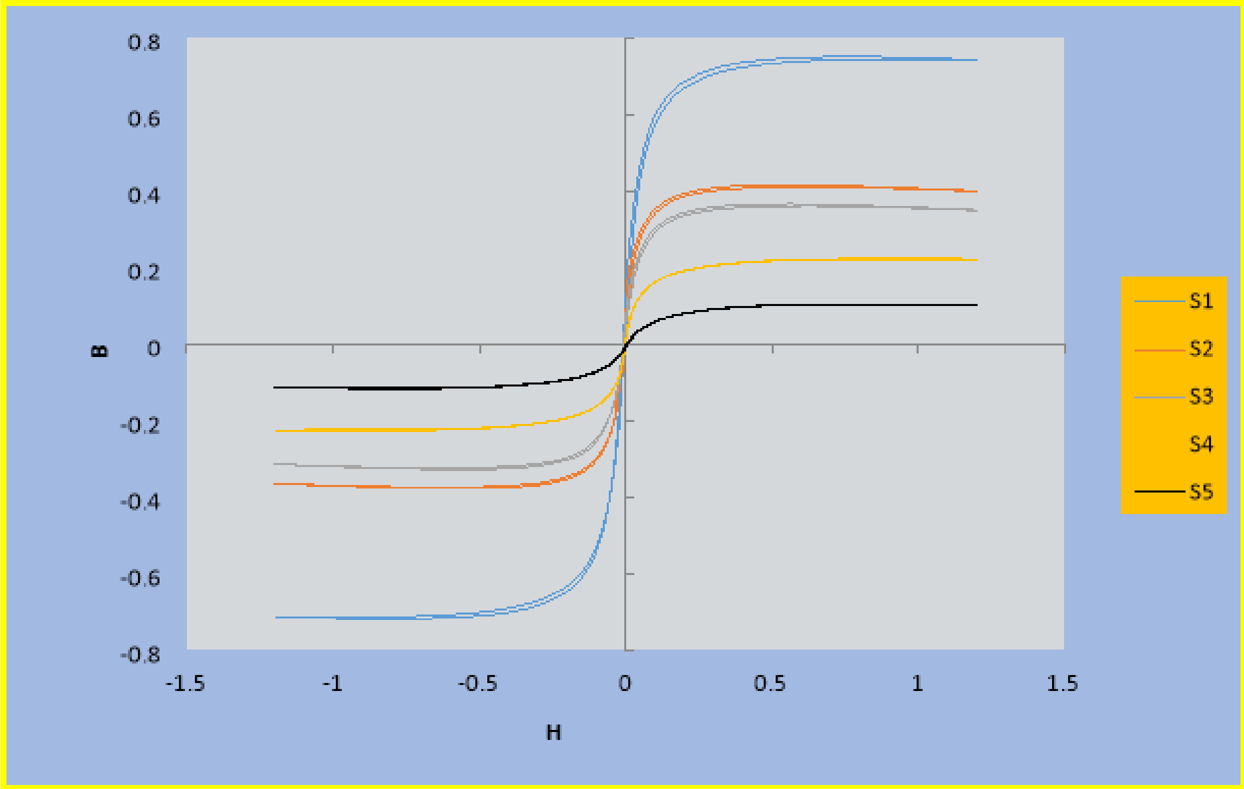


Fig4: Magnetic properties such as hysterical loop.

It is well known that the compound UPE / MCNT- $ZnFe_2O_3$ has a spindle structure and has a soft magnetic behavior through the information and calculations that were performed through this examination in figures 5 (a ,b ,c and d), which we note where The difference in the saturation magnetism, force of force and residual magnetism, as well as the magnetic moment with the concentration ratio of the prepared samples, and in general this difference is due to the difference in crystallinity as well as the shape and size of the nanoparticles of the nanocomposites.

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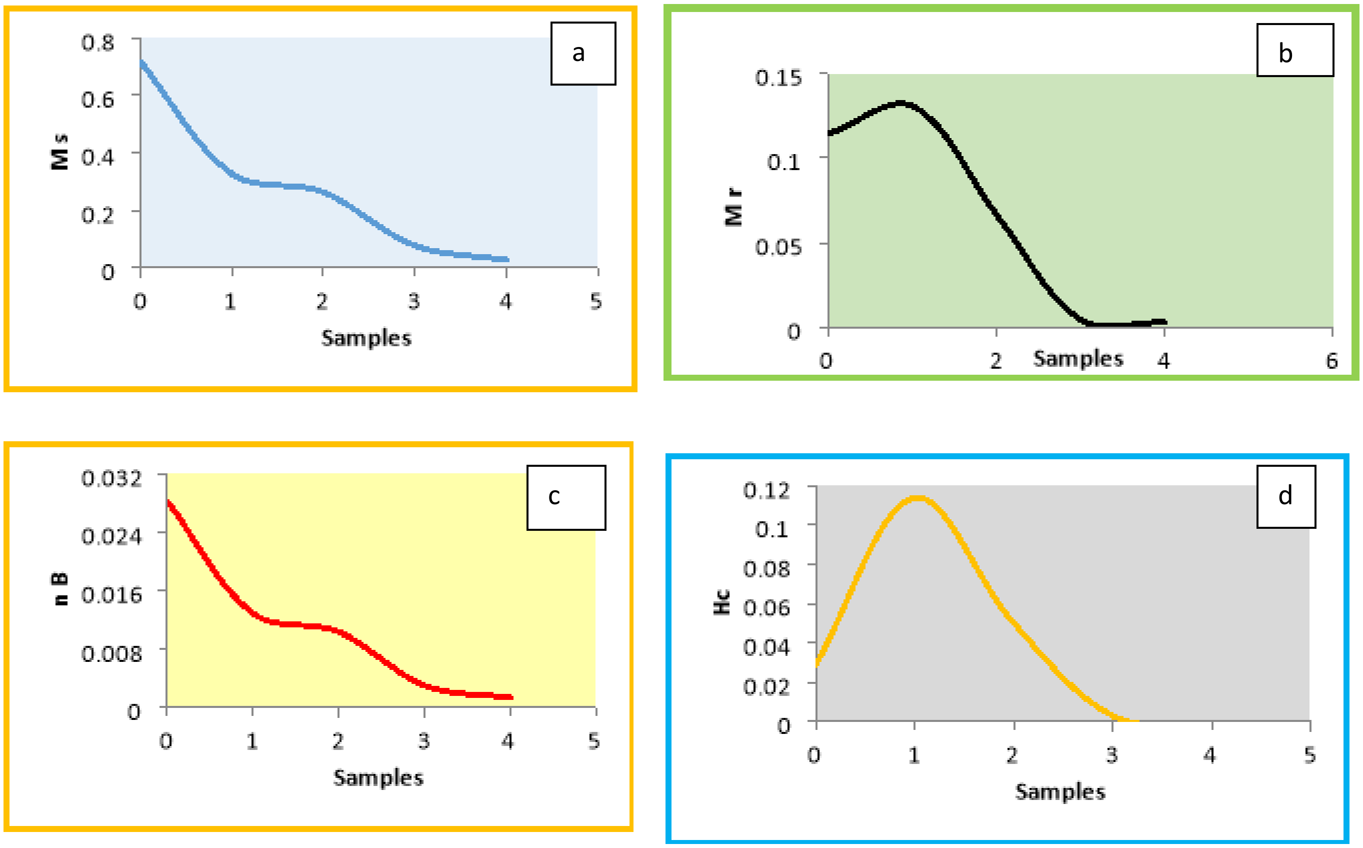

Fig. 5: a. The saturation magnetization changes with the concentration ratio of the samples, b. The residual magnetism changes with the concentration ratio of the samples, c. Magnetic moment change with concentration ratio of samples, d. The coercive force changes with the concentration ratio of the samples.

Conclusions:

The conclusions are summarized through the practical results of the VSM device, where it was observed that there is a difference in the values of the magnetization of saturation, coercive force, magnetic moment, as well as the residual magnetism when increasing the concentration of nanoparticle zinc. In general, this difference is due to the smallness of the granular size and the increase of the surface area of the Nano powder. Therefore, the saturation region decreases and so does the coercive force of the nanocomposites.

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