Cause and Effect of Implementation of an Inexpensive Torque According to the Magnetic Anisotropy and Various Magnetic Materials

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Abstract
This research investigates the Cause and effect of implementation of an inexpensive torque according to the magnetic anisotropy and various magnetic materials. Data were collected from various secondary and primary sources.The second part of the work involves the construction of transverse pick-up coil system which was added to the vibrating sample magnetometer (VSM) and enable the measurement of the transverse component of the moment .The result from the analysis of torque curves and measurement of anisotropy constants is done by the using this double coil system in the VSM .A clear picture of the rotation of the two transverse components Q x (OH) o the total moment (M) as well as the orientation of the next moment due to the presence of two competing torques is obtained for the vocally and Fe-Cr-Co alloy samples variation in the magnitudes of anisotropy constant obtained is discussed as a function of relative cobalt concentrations.A medium is said to be anisotropic if any of its inherent physical quantity differ in value along different within the material .Material sciences of phenomena including electrical receptivity dielectric behavior and the magnetization of the materials They are explained on the basis of their anisotropy. Magnetic anisotropy is defined as the dependence of internal energy on the direction of spontaneous magnetization .in ferromagnetic substance material a coupling between the magnetic moments is very large, and the movement is very large and the moments tend to be parallel with each other in small regions called domains. The boundary between the domains is not sharp on the atomic scale but is spread over a certain thickness wherein the direction of spins changes gradually from one domain to the next. This layer is usually called a domains wall. It is now small magnets or domains each of which consists of many atoms and the atoms and the atomic spins interact with each other each of them trying to align the others in its own direction. Within a domain, all of the atoms are aligned parallel, and the domain is it's thus saturated even when no field is applied. The material is therefore said to be spontaneously magnetized. The magnitude of magnetization in the material is then called its romance. The interaction which originates from quantum mechanical properties of the spins between the atomic spins is called the exchange interaction

Introduction: Displacements of the domains walls and the rotation of local magnetic moments are Two mechanisms which govern the variation of the magnetization vector in the presence of an Applied field. Magnetic anisotropy also influences the domain wall motion and its structure. Another important parameter is the coercively (Hc) of the material, i.e., the field required to Reduce the flux density to zero in a magnetic material. The coercive force is often used as a Measure of softness or hardness of the materials. It too has a dependence on the anisotropy in various models. However, coactivity is principally determined by the presence of pinning sites

Of defects which tend to block the motion of domain walls. We shall use coactivity as the Measure of the field values which determine the relatively high field. Similarly, coactivity Samples will be referred as hard samples. On the base of the direction of magnetization, anisotropy can be categorized as uniaxial Anisotropy, i.e., there is only one direction of spontaneous magnetization as in case of single Crystal of hexagonal cobalt Co, c-axis is only the preferred direction of magnetization (Fig.1.1). Similarly, on the base of symmetry of the crystal structure of the materials, there can Exit more than one direction of spontaneous magnetization, e.g., in some cubic crystal, Principal cubic axes or the cube diagonal are noticed as the preferred direction of Magnetization. Such type of anisotropy dependency is put into the category of the cubic anisotropy Curves or hysterias loops for different magnetic materials when they are subjected to stress. In Ni the permeability (relative increase in flux caused by the presence of the magnetic material) Is greatly reduced by the tension and the permanence coactivity almost disappear .the direction In which tension is applied becomes a hard or non-preferred direction of magnetization .in perm Alloy on the contrary tension makes the hysterias loop more square and both eminence and Coactivity increase .in this case the tension makes the direction in which it is applied into an easy Or preferred direction of magnetization.

1.1.4 induced magnetic anisotropy The various crystals are oriented more or less at random in polycrystalline materials , And no difference was found in properties of a different direction. Therefore the magnetic Anisotropy is induced by some treatment, which has more or less directional properties. For example, most ferromagnetic alloys exhibit uniaxial anisotropy when they are heat-treated In a magnetic annealing effect. Many ferromagnetic alloys also exhibit fairly strong anisotropy When they are cold-rolled, or cold-worked called a rolled magnetic anisotropy .the process of fabrication produce some regularity in the distribution of orientation, and the magnetic properties are markedly Anisotropic. Another technique for the induction of fairly large magnetic anisotropy is to apply the magnetic field when the specimen is cooled through its phase transition point. Both the uniaxial and cubic anisotropic are observed by applying these induction methods.

1.1.5 Magneto crystllineanistrophy

Experimental measurements on ferromagnetic and ferromagnetic crystals have shown that there are certain directions along which single crystal is more easily magnetized and in General they coincide with the principle crystal symmetry directions. The idea was introduced that there are quantum mechanical interactions between electrons tend to align the spontaneous magnetization along these preferred directions. The phenomenon is called magnetocrystalline anisotropy, and it enters the theory of permanent magnets in various ways. The existence of crystalline anisotropy can be proved by the magnetization curve of single Crystal specimen Fig. 1-2. By magnetization in the direction of the applied field MH. Plotted as a function of the applied field, Magnetization curves for a single crystal of iron, nickel, and cobalt for varies retentions of the applied field with respect to the crystal axes for room temperature clearly show that much smaller fields are required to magnetize the crystal to saturation along certain directions than among others. The crystallographic axes along which the magnetization tends to lie are called easy direction; the axes along which it is most difficult to produce saturation are called hard directions (Fig.1-2).

TO investigate the effects of field direction H on magnetic moment M one needs to monitor both the longitudinal and transverse components of magnetization simultaneously. The basic idea, which we used here, is to introduce the double coil pick up a system in a commercial vibrating sample magnetometer (VSM) model BVH-50 of Riken Denshi co.ltd. Japan. given the setup of the VSM, with the field applied along said x-axis ,one may monitor the sample response along the two mutually transverse direction ,i.e., along x and y (fig.3-6). This enables one to pick up the two components 0x and oy of the magnetic moment as shown as in the fig. 3-1. The moment thus determined as a vector enables the angle (0) between the field and the moment to be determined. This provides another method by which to determine the variation in the sample orientation with field and anisotropy

Since the x-coils are provided along with the instrument, a set of pick-up coil was designed and arranged along the y-axis ,to measure the moment oy . The spatial constraints imposed by the design of the VSM created considerable problems in the designing and construction of pick up coils with the desired sensitivity.The theoretical consideration of designing essentially follow [12]. For designing of VSM pickup coils the principle of reciprocity proves to be useful, which states that the flux threading two coils is independent of which one carries the current I. since a magnetized Material of moment M can always be represented by its equivalent current, one may write for coil as Ida =MdV Where A is the cross-sectional area of the coil V is the sample volume. Figure 3-2

Shows the optimal coil configuration, in which four identical coils of N turns are used to increase the output. Furthermore, since each set of two pick-up coil placed equidistant from y= 0 is counter wound, this configuration is insensitive to external field variation once the coils have been balanced. It has been shown [12] that for finite height H and width W of the coils wound at a density of n turns per unit cross-section the output voltages at A and B are written respectively as, The total moment M can be calculated measuring the electromagnetic signal 0 x and 0y on x And y pick-up coils respectively, by using the relation.

M = Also we can determine the angle, which the moment M marks with the direction of applied
Field Has (fig. 3-1),
0=3.1 Designing and experiment setup of Y pick-up coil

The design of they pick-up coil had to take into account the limitations of the VSM. The space between the VSM pick-up coils was only 4 cm, so they pick-up coils Had to have a maximum diameter <4 cm. the one main cancers in designing the pick-Up coils (apart from the space limitations) is that the outer edge of the coil subtends an

3.1.2 Holding assembly of the Y pick-up coils

We used a Perspex block of dimension $56x37x26mm^3$ the fur coil as shown in the fig.3-4 At the two sides of the block four grooves were made, two at each side, for four coils. A through hole of diameter 13 mm was made exactly at the center, parallel to the planes of grooves, to provide the space for sample vibrations. All these dimensions were made in accordance with the above-described limitations. This whole assembly was again fitted in the Styrofoam frame so as to tightly fit the four-coil system between the spaces available among x pick-up coils.

3.1.3 Sample holding Assembly

Again the spatial limitations were imposed in designing the assembly for holding the sample with the vibrating rod of VSM. As there was only the gap of 13 mm within the coil holding assembly, therefore we use a thin glass rod having diameter=3mm and length 83mm. The glass rod was attached to the vibrator by means of a Teflon coupling. A small sample holder of lifelong is also fixed with the glass rod where we glued our samples (fig.3-5). We have ensured the alignment of vibrating rod with Teflon coupling, glass rod, and sample holder, using the lathe machine.

3.1.4 Law Cooling Arrangement

To carry out measurement at a low temperature of at liquid nitrogen temperature (77k), we made a glass Seward that has the capability to hold the liquid nitrogen for quite long time (up to 25 minutes without rifling). The design of this double walled glass tube had to be made considering the space available for sample vibration and the dimension of coil holding assembly for sample vibrations and the dimension of coiled assembly there for the lower part of outwear hazed 12mm and, i.e., 6.5mm, so one may easily insert this doubled tube in the 13mm hole available for sample. The space of 6.5mm again put the lamination 0n a sample dimension as well as on the alignment of the sample rod. The diameter of the upper part of the tube was taken as large as possible (less than the spacing between x coils), to enhance the time between rifling.

For the being we do not have sample having desirable properties to change with the temperature .in near future we will use this assembly of low cooling system

3.2 circuital arrangements

Figure3-6 show the circuited diagram for simultaneous data as question of x and y pick-up cools both LIA and LIA 2 are fed separate inputs from the x and y coil esrespectily the reference single of 1v p-p and 33 HZ from the vibration motor of the VSM is divided at LIA 1 and is fed to LIA 2 through an operational amplifier circuit with a gain of 3. Done because the reference
Voltage drops below the minimum level of 300 my required for the reference signal of LIA. The lock-in amplifier was found to lock simultaneously thereafter.

Conclusions:

The basic idea, which we used here, is to introduce the double coil pick up a system in a commercial vibrating sample magnetometer (VSM) model BHV-50 of Riken Denshi co.ltd. Japan. given the setup of the VSM, with the field applied along said x-axis ,one may monitor the sample response along the two mutually transverse direction ,i.e. along x and y (fig.3-6). This enables one to pick up the two components 0x and oy of the magnetic moment as shown as in the fig. 3-1. The moment thus determined as a vector enables the angle (0) between the field and the moment to be determined. This provides another method by which to determine the variation in the sample orientation with field and anisotropy Since the x-coils are provided along with the instrument, a set of pick-up coil was designed and arranged along y-axis ,to measure the moment oy . The spatial constraints imposed by the design of the VSM created considerable problems in the designing and construction of pick up coils with the desired sensitivity.

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