Magnetic effect builder and an estimator of the object to make it float, pull, slow or make it fast...

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Abstract:

Magnetism is a property of materials that respond to an applied magnetic field. Permanent magnets have persistent magnetic fields caused by ferromagnetism. That is the strongest and most familiar type of magnetism. However, all materials are influenced varyingly by the presence of a magnetic field. Some are attracted to a magnetic field (paramagnetism); others are repulsed by a magnetic field (diamagnetism); others have a much more complex relationship with an applied magnetic field (spin glass behavior and antiferromagnetism). Substances that are negligibly affected by magnetic fields are known as **non-magnetic** substances. They include copper, aluminium, gases, and plastic. Pure oxygen exhibits magnetic properties when cooled to a liquid state.

The magnetic state (or phase) of a material depends on temperature (and other variables such as pressure and applied magnetic field) so that a material may exhibit more than one form of magnetism depending on its temperature, etc.

Introduction:

Paramagnetism

It is a form of magnetism whereby the paramagnetic material is only attracted when in the presence of an externally applied magnetic field. Paramagnetic materials have a relative magnetic permeability greater or equal to unity (i.e., a positive magnetic susceptibility) and hence are attracted to magnetic fields. The magnetic moment induced by the applied field is linear in the field strength and rather weak.

It typically requires a sensitive analytical balance to detect the effect and modern measurements on paramagnetic materials are often conducted with a SQUID magnetometer. Paramagnetic materials have a small, positive susceptibility to magnetic fields. These materials are slightly attracted by a magnetic field and the material does not retain the magnetic properties when the external field is removed. Paramagnetic properties are due to the presence of some unpaired electrons, and from the realignment of the electron paths caused by the external magnetic field.

Paramagnetic materials include magnesium, molybdenum, lithium, and tantalum. Unlike ferromagnets, paramagnets do not retain any magnetization in the absence of an externally applied magnetic field, because thermal motion randomizes the spin orientations. Some paramagnetic materials retain spin disorder at absolute zero, meaning they are paramagnetic in the ground state. Thus the total magnetization drops to zero when the applied field is removed.

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Even in the presence of the field there is only a small induced magnetization because only a small fraction of the spins will be oriented by the field. This fraction is proportional to the field strength and this explains the linear dependency. The attraction experienced by ferromagnetic materials is non-linear and much stronger, so that it is easily observed, for instance, by the attraction between a refrigerator magnet and the iron of the refrigerator itself.

Curie's law

For low levels of magnetization, the magnetization of paramagnets follows what is known as Curie's law, at least approximately. This law indicates that the susceptibility χ of paramagnetic materials is inversely proportional to their temperature, i.e. that materials become more magnetic at lower temperatures. The mathematical expression is:

$$\boldsymbol{M} = \chi \boldsymbol{H} = \frac{C}{T} \boldsymbol{H}$$

where:

M is the resulting magnetization

χ is the magnetic susceptibility

H is the auxiliary magnetic field, measured in amperes/meter

T is absolute temperature, measured in kelvins

C is a material-specific Curie constant

Diamagnetism

It is the property of an object or material which causes it to create a magnetic field in opposition to an externally applied magnetic field. Diamagnetism is believed to be due to quantum mechanics (and is understood in terms of Landau levels[1]) and occurs because the external field alters the orbital velocity of electrons around their nuclei, thus changing the magnetic dipole moment. According to Lenz's law, the field of these electrons will oppose the magnetic field *changes* provided by the applied field. The magnetic permeability of diamagnets is less than μ_0 (a relative permeability less than 1). In most materials diamagnetism is a weak effect, but in a superconductor a strong quantum effect repels the magnetic field entirely, apart from a thin layer at the surface.

Diamagnets were first discovered when Sebald Justinus Brugmans observed in 1778 that bismuth and antimony were repelled by magnetic fields. The term *diamagnetism* was coined by Michael Faraday in September 1845, when he realized that every material responded (in either a diamagnetic or paramagnetic way) to an applied magnetic field.

Curving water surfaces

If a powerful magnet (such as a supermagnet) is covered with a layer of water (that is thin compared to the diameter of the magnet) then the field of the magnet significantly repels the water. This causes a slight dimple in the water's surface that may be seen by its reflection.[3][4]

Diamagnetic levitation

A live frog levitates inside a 32 mm diameter vertical bore of a Bitter solenoid in a magnetic field of about 16 teslas at the Nijmegen High Field Magnet Laboratory.

Diamagnets may be levitated in stable equilibrium in a magnetic field, with no power consumption. Earnshaw's theorem seems to preclude the possibility of static magnetic levitation. However, Earnshaw's theorem only applies to objects with positive moments, such as ferromagnets (which have a permanent positive moment) and paramagnets (which induce a positive moment). These are attracted to field maxima, which do not exist in free space. Diamagnets (which induce a negative moment) are attracted to field minima, and there can be a field minimum in free space.

A thin slice of pyrolytic graphite, which is an unusually strong diamagnetic material, can be stably floated in a magnetic field, such as that from rare earth permanent magnets. This can be done with all components at room temperature, making a visually effective demonstration of diamagnetism.

The Radboud University Nijmegen, the Netherlands, has conducted experiments where water and other substances were successfully levitated. Most spectacularly, a live frog (see figure) was levitated.

In September 2009, NASA's Jet Propulsion Laboratory in Pasadena, California announced they had successfully levitated mice using a superconducting magnet, an important step forward since mice are closer biologically to humans than frogs. They hope to perform experiments regarding the effects of microgravity on bone and muscle mass.

Recent experiments studying the growth of protein crystals has led to a technique using powerful magnets to allow growth in ways that counteract Earth's gravity.

A simple homemade device for demonstration can be constructed out of bismuth plates and a few permanent magnets that will levitate a permanent magnet

Diamagnetism in metals

The Langevin theory does not apply to metals because they have non-localized electrons. The theory for the diamagnetism of a free electron gas is called Landau diamagnetism, and instead considers the weak counter-acting field that forms when their trajectories are curved due to the Lorentz force. Landau diamagnetism, however, should be contrasted with Pauli paramagnetism, an effect associated with the polarization of delocalized electrons' spins.

Antiferromagnetism

The magnetic moments of atoms or molecules, usually related to the spins of electrons, align in a regular pattern with neighboring spins (on different sublattices) pointing in opposite directions. This is, like ferromagnetism and ferrimagnetism, a manifestation of ordered magnetism. Generally, antiferromagnetic order may exist at sufficiently low temperatures, vanishing at and above a certain temperature, the Néel temperature (named after Louis Néel, who had first identified this type of magnetic ordering).[1] Above the Néel temperature, the material is typically paramagnetic.

Antiferromagnetism plays a crucial role in giant magnetoresistance, as had been discovered in 1988 by the Nobel prize winners Albert Fert and Peter Grünberg (awarded in 2007).

Magnetochemistry

It is concerned with the magnetic properties of chemical compounds. Magnetic properties arise from the spin and orbital angular momentum of the electrons contained in a compound. Compounds are diamagnetic when they contain no unpaired electrons. Molecular compounds that contain one or more unpaired electrons are paramagnetic. The magnitude of the paramagnetism is expressed as an effective magnetic moment, μ_{eff}. For first-row transition metals the magnitude of μ_{eff} is, to a first approximation, a simple function of the number of unpaired electrons, the spin-only formula. In general, spin-orbit coupling causes μ_{eff} to deviate from the spin-only formula. For the heavier transition metals, lanthanides and actinides, spin-orbit coupling cannot be ignored. Exchange interaction can occur in clusters and infinite lattices, resulting in ferromagnetism, antiferromagnetism or ferrimagnetism depending on the relative orientations of the individual spins.

When an isolated atom is placed in a magnetic field there is an interaction because each electron in the atom behaves like a magnet, that is, the electron has a magnetic moment. There are two type of interaction.

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1. Diamagnetism. Every electron is paired with another electron in the same atomic orbital. The moments of the two electrons cancel each other out, so the atom has no net magnetic moment. When placed in a magnetic field the atom becomes magnetically polarized, that is, it develops an induced magnetic moment. The force of the interaction tends to push the atom out of the magnetic field. By convention diamagnetic susceptibility is given a negative sign.
2. Paramagnetism. At least one electron is not paired with another. The atom has a permanent magnetic moment. When placed into a magnetic field, the atom is attracted into the field. By convention paramagnetic susceptibility is given a positive sign.

When the atom is present in a chemical compound its magnetic behaviour is modified by its chemical environment. Measurement of the magnetic moment can give useful chemical information.

The Effects:

Photomagnetic effect is a theoretical quantum mechanical effect discovered by the researchers Samuel L. Oliveira and Stephen C. Rand at University of Michigan 2007-2011. [1] [2] [3] [4] The researchers has discovered a powerful magnetic interaction between the photons dynamic magnetic field - and certain isolator materials atoms magnetic moment, that is 100 million times stronger than formerly anticipated. Under the proper circumstances, the photons magnetic fields effect is as strong as their electric field - as e.g. in solar cells.

The discovery is a surprise, because it is not straightforward to derive the strong magnetic effect from the physical equations, and thereby indicate that this quantum mechanical effect would be interesting enough. That is why the photomagnetic effect has been neglected for more than 100 years.

The researchers has theoretically calculated that incoherent light as e.g. sunlight, is almost as efficient as laserlight, to be converted by the photomagnetic effect.

In 2011 the power density should be 10 million watt per square centimeter, but the researchers will look for new photomagnetic materials, that can work with lower light intensities.

Magneto-optic Kerr effect (MOKE) or the surface magneto-optic Kerr effect (SMOKE) is one of the magneto-optic effects. It describes the changes to light reflected from a magnetized surface. It is used in materials science research in devices such as the Kerr microscope, to investigate the magnetization structure of materials.

Microscopy

A Kerr microscope relies on the MOKE in order to image differences in the magnetization on a surface of magnetic material. In a Kerr microscope, the illuminating light is first passed through a polarizer filter, then reflects from the sample and passes through an *analyzer* polarizing filter, before going through a regular optical microscope. Because the different MOKE geometries require different polarized light, the polarizer should have the option to change the polarization of the incident light (circular, linear, and elliptical). When the polarized light is reflected off the sample material, a change in any combination of the following may occur: Kerr rotation, Kerr ellipticity, or polarized amplitude. The changes in polarization are converted by the analyzer into changes in light intensity, which are visible. A computer system is often used to create an image of the magnetic field on the surface from these changes in polarization.

In conjunction with the Kerr microscope, Magneto Optical Imaging Films (MOIF) can be used to better image magnetic domains in ferromagnetic materials. These films can be made out of an Yttrium Iron Garnet and are usually substituted with certain rare earth elements. Because the manufacturing process of these films is so specialized, they aren't commercially available.

Magnetic Media

Magneto Optical (MO) Drives were introduced in 1985, and were originally WORM (write once, read many) drives, meaning they could be added to but not erased. Although they are not widely used today, they were reliable both in accurate writing and consistent data retention. Typical sizes ranged from 100 megabytes (MB) up to 9.2 gigabytes (GB). MO drives checked the data as it was being written, and thus took longer than typical CD's or DVD's. However this allowed for increased data integrity.

MO discs were written using laser and an electromagnet. The laser would heat the platter above its Curie Temperature and which point the electromagnet would orient that bit as a 1 or 0. To read, the laser is operated at a lower intensity, and emits polarized light. Reflected light is analyzed showing a noticeable difference between a 0 or 1.

Magneto-optic effect is any one of a number of phenomena in which an electromagnetic wave propagates through a medium that has been altered by the presence of a quasistatic magnetic field. In such a material, which is also called **gyrotropic** or **gyromagnetic**, left- and right-rotating elliptical polarizations can propagate at different speeds, leading to a number of important phenomena. When light is transmitted through a layer of magneto-optic material, the result is called the Faraday effect: the plane of polarization can be rotated, forming a Faraday rotator. The results of reflection from a magneto-optic material are known as the magneto-optic Kerr effect (not to be confused with the nonlinear Kerr effect).

In general, magneto-optic effects break time reversal symmetry locally (i.e. when only the propagation of light, and not the source of the magnetic field, is considered) as well as Lorentz reciprocity, which is a necessary condition to construct devices such as optical isolators (through which light passes in one direction but not the other). (The other, less useful, way to break time reversal symmetry is to rely upon absorption loss.)

Two gyrotropic materials with reversed rotation directions of the two principal polarizations, corresponding to complex-conjugate ε tensors for lossless media, are called optical isomers.

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Analysis:

Thus By using the properties and effects of magnetism one can better program it and infuse it various models to control the effects and phenomenon of magnetism like the attraction, repulsion, to float a object and to slow a object and to act as a resistance to magnetism... Many such devices can be made to have a control practice of magnetism in a safe environment and it will be a great technology i.e Magnetism Technologies and Applications ...

In this One can couple up the elements of product the desired effect of magnetism, here chemical can be used as a fuel, metals as the body and gases as the coolant to give the effect of Magnetism. Iron and Other metals all around, let it be our cars, or vehicles or construction sites works or at home .... Better to have a safe Magnetism technologies for the people and for work to give a flexibility of control and operation to work and to use as a life saver too.... Can be used in defense works too ... The bullets and guns and tanks are usually of metal ... Aren't they ????

We can have such huge magnetism fields to produce magnetism effects to even pull a tank ... Or repel a missile with great force.... or divert it ...

Conclusion:

Thus Magnetism is a powerful and a very useful technology and should be used effectively to create great devices and applications and make the life of the people more flexible and fast...

Reference:

- The wikipedia
- The H.C. Verma of IIT Physics Vol 1 and 2...