Magnetism

Terms and Definitions in Magnetism and Matter

1. **Magnetisation (M)**
   - Definition: Net magnetic moment per unit volume.
   - Formula: $M = \frac{m_{\text{net}}}{V}$
   - Units: A·m$^{-}1$
   - Description: A measure of the magnetic moment density in a material.
2. **Magnetic Intensity (H)**
   - Definition: External magnetic field strength in a material.
   - Formula: $H = \frac{B}{\mu_0} - M$
   - Units: A·m$^{-}1$
   - Description: Represents the magnetic field due to external sources, excluding the material's response.
3. **Magnetic Field (B)**
   - Definition: Magnetic field strength within a material.
   - Formula: $B = \mu_0(H + M)$
   - Units: Tesla (T)
   - Description: The total magnetic field, including contributions from both external sources and the material itself.
4. **Magnetic Susceptibility (χ)**
   - Definition: Degree of magnetisation of a material in response to an applied magnetic field.
   - Formula: $\chi = \frac{M}{H}$
   - Description: Indicates how easily a material can be magnetised. Positive for paramagnetic and ferromagnetic materials, negative for diamagnetic materials.
5. **Relative Magnetic Permeability (μr)**
   - Definition: Ratio of the permeability of a material to the permeability of free space.
   - Formula: $\mu_r = 1 + \chi$
   - Description: Dimensionless quantity indicating the extent to which a material can be magnetised.
6. **Magnetic Permeability (μ)**
   - Definition: Measure of the ability of a material to support the formation of a magnetic field.
   - Formula: $\mu = \mu_0 \mu_r$
   - Units: T·m/A
   - Description: Higher values indicate that the material is more permeable to magnetic fields.
7. **Gauss's Law for Magnetism**
   - Definition: The net magnetic flux through any closed surface is zero.
   - Formula: $\Phi_B = \oint_S \mathbf{B} \cdot d\mathbf{A} = 0$
   - Description: Implies that magnetic monopoles do not exist and magnetic field lines form closed loops.
8. **Magnetic Dipole Moment (m)**
   - Definition: A measure of the strength and orientation of a magnet's magnetic field.
   - Units: A·m^{2}

- Description: Represents the torque experienced by a magnet in a magnetic field.

9. **Magnetic Flux (ΦB)**
   - Definition: Measure of the quantity of magnetism, considering the strength and extent of a magnetic field.
   - Formula: $\Phi_B = \int_S \mathbf{B} \cdot d\mathbf{A}$
   - Units: Weber (Wb)
   - Description: Total magnetic field passing through a given area.
10. **Ferromagnetic Materials**
   - Definition: Materials that exhibit strong magnetic properties and can be permanently magnetised.
   - Examples: Iron, cobalt, nickel
   - Description: Have large and positive magnetic susceptibility, forming strong internal magnetic fields.
11. **Paramagnetic Materials**
   - Definition: Materials that are weakly attracted by an external magnetic field and form temporary magnets.
   - Examples: Aluminum, calcium
   - Description: Have small and positive magnetic susceptibility, with induced magnetisation proportional to the external field.
12. **Diamagnetic Materials**
   - Definition: Materials that are repelled by a magnetic field and do not retain magnetic properties.
   - Examples: Copper, bismuth
   - Description: Have small and negative magnetic susceptibility, causing induced magnetic fields in the opposite direction of the applied field.
13. **Hysteresis**
   - Definition: Lag between changes in the magnetisation of a material and changes in the magnetic field.
   - Description: Evident in ferromagnetic materials, representing energy loss in the form of heat during the magnetisation cycle.
14. **Curie's Law**
   - Definition: Magnetisation of a paramagnetic material is inversely proportional to its temperature.
   - Formula: $M = \frac{C \cdot B_0}{T}$
   - Description: Demonstrates that the magnetic properties of paramagnetic materials decrease with increasing temperature.
15. **Permanent Magnets**
   - Definition: Substances that retain their magnetic properties even after the external magnetic field is removed.
   - Examples: Alnico, ferrite
   - Description: Made from ferromagnetic materials with high retentivity and coercivity.

These terms and definitions cover key concepts in the study of magnetism and matter as described in the provided document.