Hysteresis

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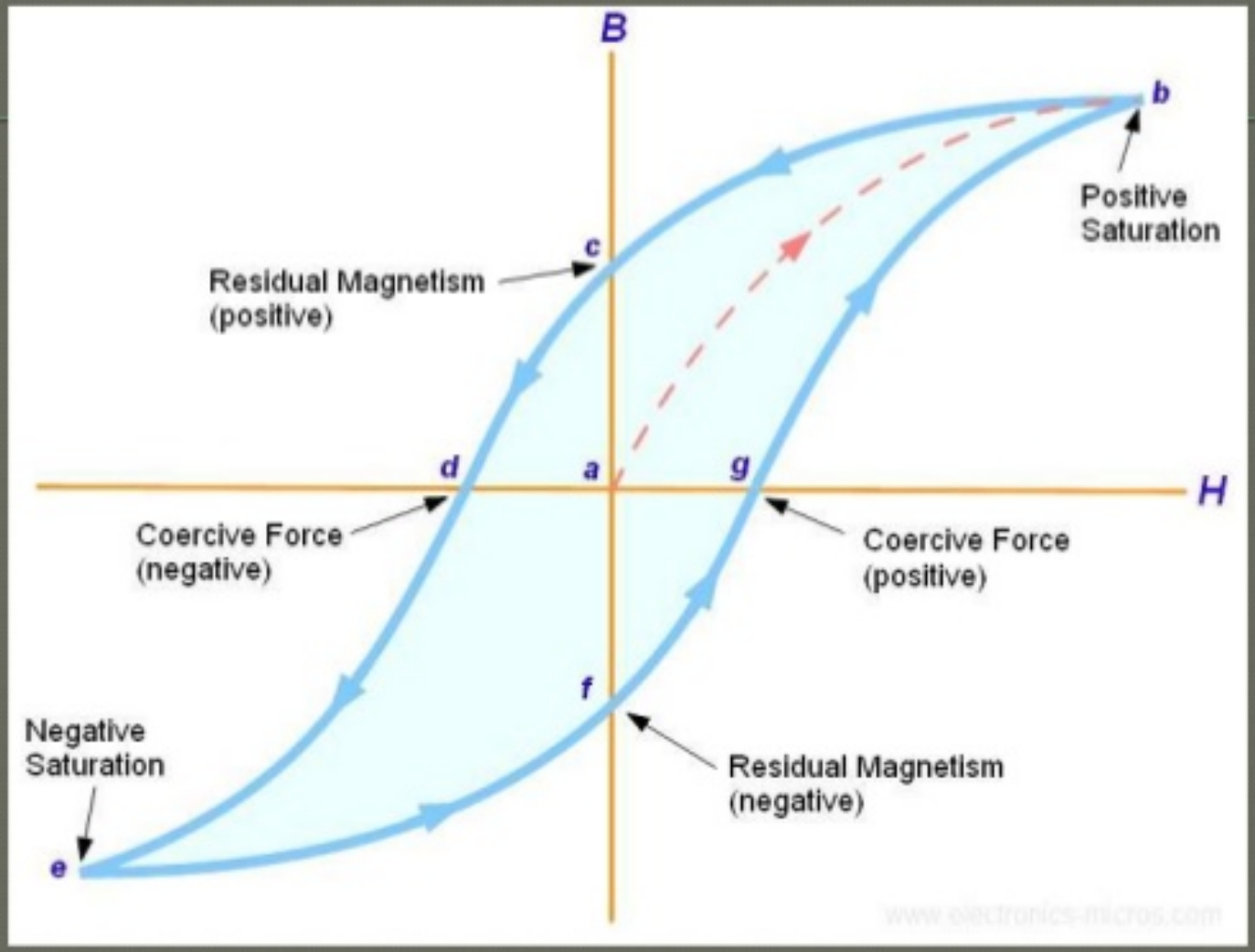
- Hysteresis, in general, is defined as the lag in a variable property of a system with respect to the effect producing it as this effect varies. In ferromagnetic materials the magnetic flux density B lags behind the changing external Magnetizing field Intensity H. Hysteresis curve is drawn by plotting the graph of B-field vs H (or M-H) by taking the material through a complete cycle of H values as follows

- The plot of Magnetization M or Magnetic field B as a function of Magnetic Field Intensity H (i.e. M-H or B-H graph) gives the Hysteresis curve. The permeability μ of a ferromagnetic material can vary through the entire range of possible values from zero to infinity and may be either positive or negetive.

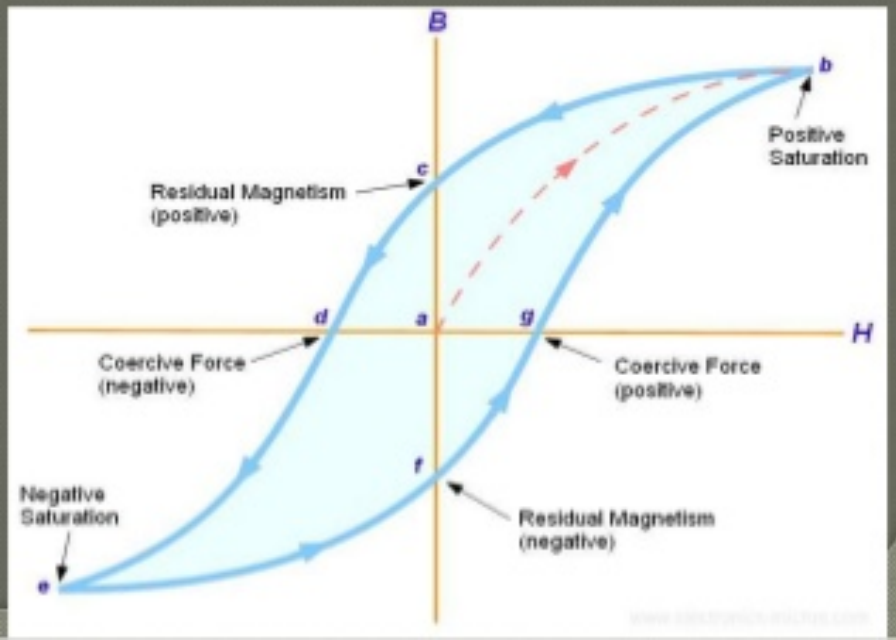


- Fig. Typical B-H graph (Hysteresis curve) of a ferromagnetic material

- First, consider an unmagnetized sample of ferromagnetic material. The magnetic field intensity H is initially zero at O. H is increased monotonically, then magnetic induction B increases nonlinearly along the curve (OACDE) called as the magnetization curve. At point E almost all of the magnetic domains are aligned parallel with the magnetic field.

- An additional increase in H does not produce any increase in B. E is called as the point of magnetic saturation of the material. Values of permeability derived from the formula along the curve are always positive and show a wide range of values. The maximum permeability as large as occurs at the ``knee'' (point D) of the curve

- Next H is decreased till it reduces to zero. B reduces from its saturation value at "E" to that at point "F". Some of the magnetic domains lose their alignment but some maintain alignment i.e. Some magnetic flux density B is still retained in the material



- The curve for decreasing values of H (i.e. Demagnetization curve EF) is offset by an amount FO from that for increasing values of H (i.e. Magnetization curve OE). The amount of offset “FO” is called the retentivity or the remanence or the level of residual magnetism.

- H is increased back from zero to maximum in the positive direction. Then B reaches zero value at “K” i.e. it does not pass through the origin of the graph. OK indicates the amount of field H required to nullify theresidual magnetism OJ retained in the opposite direction. H is increased from point “K” further in the positive direction, then again the saturation of B is reached at point “E” and the loop is completed.

- 1.Retentivity - A measure of the residual flux density corresponding to the saturation of a magnetic material. It is a material's ability to retain a certain amount of residual magnetic field when the magnetizing force is removed after achieving saturation (The value of B at point E on the hysteresis curve).

- 2. Residual Magnetism or Residual Flux - The magnetic flux density B that remains in a material when the magnetizing field intensity H is zero. Residual magnetism and retentivity are same only when the material is magnetized to the saturation point. However, it may be lower than the retentivity value otherwise.

- 3. Coercive Forc Coercivity It is the amount of reverse magnetizing field intensity which must e or be applied to a magnetic material to make the magnetic flux density of ferromagnetic material return to zero after it has reached saturation. (The value of H at point G on the hysteresis curve).

- 4. Reluctance - It is the opposition that a ferromagnetic material shows to the establishment of a magnetic field. Reluctance is analogous to the resistance in an electrical circuit

- 5.Permeability, μ- Permeability is the property of a material that measures the ease with which a magnetic flux is established in it. μ is negative in the II and IV quadrants and positive in the I and III quadrants of the B-H graph (i.e. the Hysteresis curve).

Thank you