3.6 Magnetization

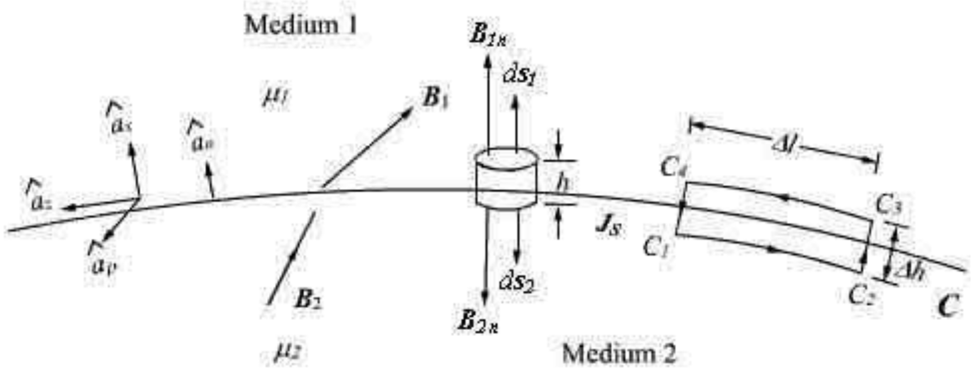
Magnetic polarization is the vector field that expresses the density of permanent or induced magnetic dipole moments in a magnetic material. The origin of the magnetic moments responsible for magnetization can be either microscopic electric currents resulting from the motion of electrons in atoms, or the spin of the electrons or the nuclei. Net magnetization results from the response of a material to an external magnetic field, together with any unbalanced magnetic dipole moments that may be inherent in the material itself.

Magnetic field in multiple media

Similar to the boundary conditions in the electro static fields, here we will consider the behavior of and at the interface of two different media. In particular, we determine how the tangential and normal components of magnetic fields behave at the boundary of two regions having different permeabilities.

The figure 4.9 shows the interface between two media permeabities and , being the normal having vector from medium 2 to medium 1. Interface between two magnetic media

To determine the condition for the normal component of the flux density vector , we consider a small pill box P with vanishingly small thickness *h* and having an elementary area for the faces. Over the pill box, we can write



To determine the condition for the normal component of the flux density vector , we consider a small pill box P with vanishingly small thickness *h* and having an elementary area for the faces. Over the pill box, we can write

$$\oint_S \vec{B}.d\vec{s} = 0$$

$$\therefore \int_{\Delta S} \vec{B}_1.d\vec{S}_1 + \int_{\Delta S} \vec{B}_2.d\vec{S}_2 = 0$$

$$d\vec{S}_1 = dS\hat{a}_n$$

$$d\vec{S}_2 = dS\left(-\hat{a}_n\right)$$

$$\therefore \int_{\Delta S} B_{1n}dS - \int_{\Delta S} B_{2n}dS = 0$$

$$B_{2n} = \vec{B}_2 \cdot \hat{a}_n$$

$$B_{1n} = \vec{B}_1 \cdot \hat{a}_n \qquad B_{2n} = \vec{B}_2 \cdot \hat{a}_n$$

$$\left(B_{1n} - B_{2n}\right)\Delta S = 0$$

$$B_{1n} = B_{2n}$$

That is, the normal component of the magnetic flux density vector is continuous across the interface.

$$\hat{a}_n \cdot \left(\vec{B}_1 - \vec{B}_2\right) = 0$$

To determine the condition for the tangential component for the magnetic field, we consider a closed path C as shown in figure 4.8. By applying Ampere's law we can write

$$\oint \vec{H}.d\vec{l} = I$$

$$\int_{C_1 - C_2} \vec{H}.d\vec{l} + \int_{C_3 - C_4} \vec{H}.d\vec{l} = I$$

We have shown in figure 4.8, a set of three unit vectors , and such that they satisfy (R.H. rule). Here is tangential to the interface and is the vector perpendicular to the surface enclosed by C at the interface