3.1.1. Induced Anisotropy Energy

The induced anisotropy energies for the <100> problem and the <111> problem will be obtained in this section. The energy will be obtained within domains and within the walls through which the transition between adjacent domains is made. This will be done for walls of the form shown in Figure 3.2(a) and Figure 3.2(b).

Consider first the <100> problem and the domain walls in Figure 3.2(a). Transform Equation (3.1) to polar coordinates using

$$\alpha_1 = \sin\theta\cos\phi, \quad \alpha_2 = \sin\theta\sin\phi, \quad \text{and} \quad \alpha_3 = \cos\theta.$$

The induced anisotropy energy in a domain is easily obtained.

$$\mathcal{E}_{me}^{<100>}(\text{domain}) = b_1 e \sin^2\theta.$$

To obtain the induced anisotropy energy in the wall, the variation in $\vec{M}$ through the wall must be considered. The requirement that $\vec{\nabla}\cdot\vec{M} = 0$ through the wall is equivalent to demanding that θ be constant through the wall. The transition between adjacent domains then proceeds by a rotation of ϕ from 0 to π. The energy in the wall is

$$\mathcal{E}_{me}^{<100>} = b_1 e \sin^2\theta\cos^2\phi.$$

A slightly more difficult analysis gives for the <111> problem

$$\mathcal{E}_{me}^{<111>}(\text{domain}) = b_2 e \sin^2\theta$$

and

$$\mathcal{E}_{me}^{<111>} = b_2 e \sin^2\theta\cos^2\phi.$$

Since the form of the energies is the same for the <100> problem and the <111> problem, we will write
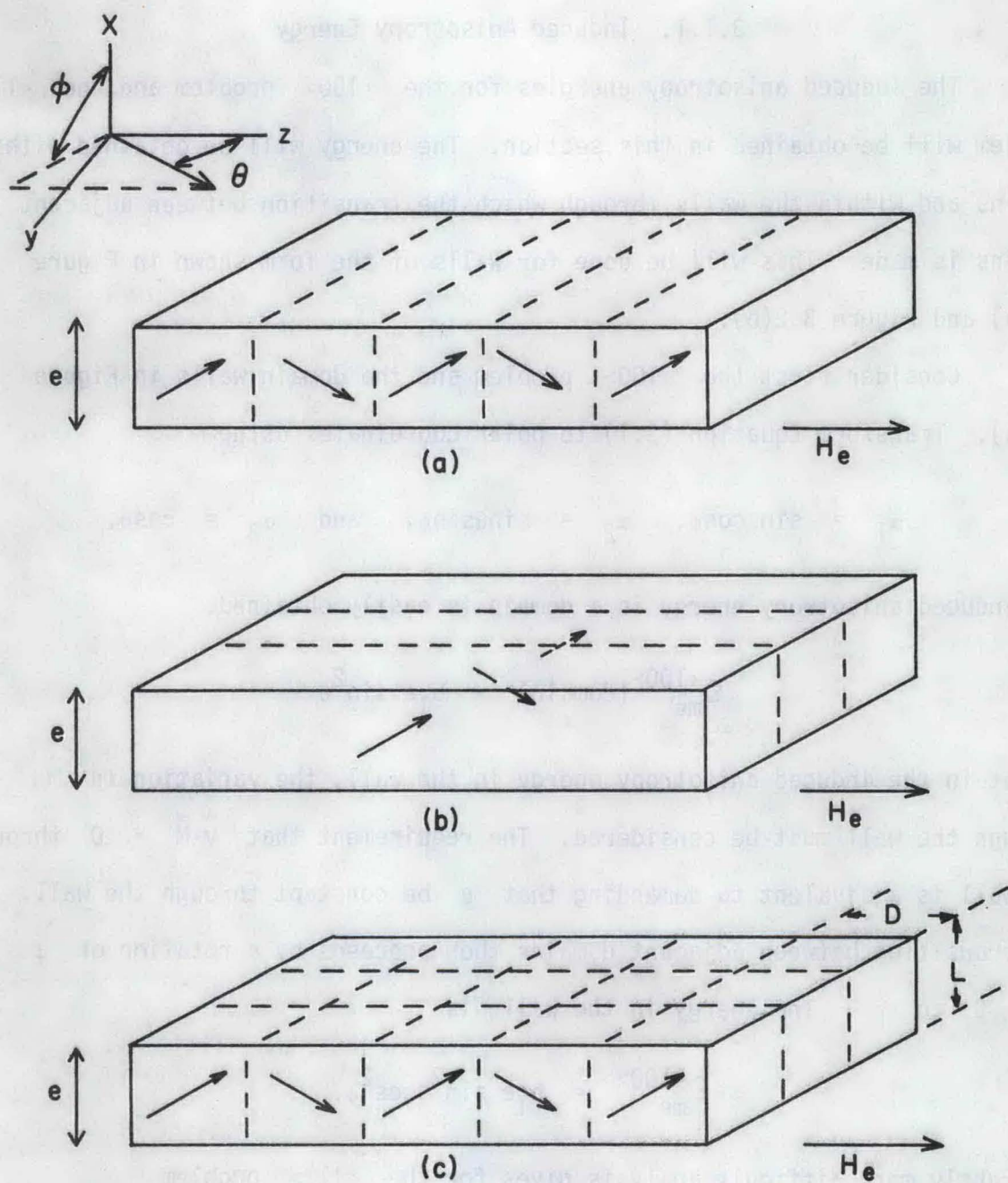
Fig. 3.2.--(a) Model for plate-like domain structure perpendicular to the applied field
(b) Model for plate-like domain structure parallel to the applied field
(c) Model for needle shaped domain structure oriented along axis of uniaxial strain. Polar angles define direction of magnetization during transition through domain wall.