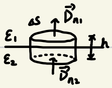
第七周周三作业 4月15日

1. 10.40 *Continuity of D* *

Use the definition of **D**, namely $\mathbf{D} \equiv \epsilon_0\mathbf{E}+\mathbf{P}$, to show that **D** is continuous across the faces of a uniformly polarized slab. Assume that the polarization is perpendicular to the faces, and that the thickness of the slab is small compared with the other two dimensions.

解:



由题意可知，取左图情形下 侧面的电位移矢量的通量忽略不记.

由高斯定理 $\oint \vec{D}\cdot d\vec{S} = D_{n1}\Delta S - D_{n2}\Delta S = \sigma\Delta S$ 其中 σ为界面处自由电荷电荷密度.

而对于两介质界面处 $\sigma=0$ 得到 $\vec{D}_{n1} = \vec{D}_{n2}$

即电位移矢量法向在均匀极化的电介质板表面连续.

由电场边界条件可知 $E_{1\parallel} = E_{2\parallel}$ $P_{1\parallel} = P_{2\parallel} = 0$

得 $D_{1\parallel} = \varepsilon_0 E_{1\parallel} + P_{1\parallel} = D_{2\parallel} = \varepsilon_0 E_{2\parallel} + P_{2\parallel}$

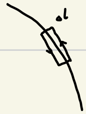
即电位移矢量切向在均匀极化的电介质板表面连续.

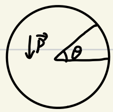
综上. 电位移矢量 D 连续.

2. 10.41 *Discontinuity in $D_\parallel$* **

Consider the polarized sphere from Section 10.9. Using the forms of the internal and external electric fields, find the discontinuity in $D_\parallel$ across the surface of the sphere, as a function of θ.

解：在角度为θ处选取微元dl





由环路定理 $\oint \vec{E}\cdot d\vec{l} = 0$

$$\vec{D}_{in} = \varepsilon_0 \vec{E}_{in} + \vec{P} = \frac{2}{3}\vec{P}$$

$$D_{in\parallel} = |\vec{D}_{in}| \cos\theta = \frac{2}{3}|\vec{P}| \cos\theta$$

$$D_{out\parallel} = \varepsilon_0 \frac{|\vec{P}|\cos\theta}{3\varepsilon_0} + 0 = \frac{1}{3}|\vec{P}|\cos\theta$$

则 $D_{in\parallel} \neq D_{out\parallel}$　　即 $D_\parallel$不连续.