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Molecular Crystals and Liquid Crystals

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Erratum

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Erratum

Bulk, Interfacial and Anchoring Energies of Liquid Crystals

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The discussion given in appendix B of the paper “Bulk, Interfacial and Anchoring Energies of Liquid Crystals” has missed its mark; the statement concerning ref. 67, i.e., is not correct. To come to the point consider again an insulating liquid crystal between two parallel electrodes at a distance d along z . Quite generally one had $D = 4\pi\sigma$ and $V = \int_0^d dz E(\vartheta) = D \int_0^d dz/\epsilon(\vartheta)$, $\vartheta = \vartheta(z)$, where σ is the surface charge density at the electrodes and V the voltage across the electrodes; both V and D are independent of z . With a given surface charge density at the electrodes the total free energy per unit area of the cell is given by,

$$\mathcal{F} = \mathcal{F}_0 + \int_0^d F_{\text{el.}} dz + \frac{D^2}{8\pi} \int_0^d \frac{dz}{\epsilon(\vartheta)},$$

which indeed after minimization yields

$$\frac{d}{dz}(F_{\text{el.}}) = \frac{D^2}{8\pi} \frac{d}{dz} \left(\frac{1}{\epsilon(\vartheta)} \right), \quad \text{where } D = 4\pi\sigma$$

is the independent variable. With a given voltage applied across the

cell one should minimize the free energy,

$$\tilde{\mathcal{F}} = \mathcal{F} - \int_0^d \frac{E \cdot D}{4\pi} dz = \mathcal{F}_0 + \int_0^d F_{\text{el.}} dz - \frac{V^2}{8\pi} \frac{1}{\int_0^d \frac{dz}{\epsilon(\vartheta)}}$$

where V is the independent variable. The variation of the field energy through a variation of $\vartheta(z)$ with $\lambda\eta(z)$ is determined by,

$$\begin{aligned} \frac{-V^2}{8\pi} \left(\frac{d}{d\lambda} \frac{1}{\int_0^d \frac{dz}{\epsilon(\vartheta + \lambda\eta)}} \right)_{\lambda=0} &= \frac{-1}{8\pi} \left(\frac{V}{\int_0^d \frac{dz}{\epsilon(\vartheta)}} \right)^2 \int_0^d dz \frac{\eta}{\epsilon^2(\vartheta)} \frac{\partial \epsilon(\vartheta)}{\partial \vartheta} \\ &= \frac{D^2}{8\pi} \int_0^d dz \eta \frac{\partial}{\partial \vartheta} \left(\frac{1}{\epsilon(\vartheta)} \right) \end{aligned}$$

yielding again

$d/dz (F_{\text{el.}}) = D^2/8\pi d/dz (1/\epsilon(\vartheta))$, however with the dependent variable D determined by $D = V/\int_0^d dz/\epsilon(\vartheta)$