1 Wetting Phenomena

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I. Introduction

The formation of liquid drops on a substrate is a common phenomenon. What makes it interesting from a physicist's point of view is the fact that the macroscopic shape of such a drop is intimately related to the three surface tensions associated with the three interfaces meeting at the contact line between the drop and the substrate: $\sigma_{g,\ell}$ is the gas–liquid, $\sigma_{\ell,s}$ the liquid–substrate, and $\sigma_{g,s}$ the gas–substrate surface tension. These quantities are given by the surface contribution to the free energy of the system, which is obtained by a suitable subtraction of the volume contribution (see, e.g., Griffiths, 1980; Pandit *et al.*, 1982). A lot of theoretical effort has been put into calculating these surface tensions by statistical mechanics on the basis of the intermolecular forces involved in the problem. It is interesting to see these forces showing up in a macroscopic way as described in the following.

The shape of a drop on a substrate, the so-called sessile drop, is given by the minimum of the total free energy of the system under the constraint of the given volume of the drop. The equilibrium shape may be obtained by minimizing the variational functional (see, e.g., Avron *et al.*, 1983):

$$E = \int \tilde{\sigma}(\hat{\boldsymbol{n}})\, \mathrm{d}S + \int \phi(\boldsymbol{x})\, dV \tag{1.1}$$

where $\hat{\boldsymbol{n}}$ denotes the outwards directed normal to the surface of the drop