Module 2: "Capliarity"

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The Lecture Contains:

- Surface Interfacial Tension

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Surface & Interfacial Tension

Surface and interfacial tensions are present whenever there is one or more condensed phase present. When there is only one condensed phase (solid or liquid), we talk of surface tension whereas if two condensed phase are in contact we talk about interfacial tension. But both the terms represent energy per unit surface area or force per unit length.

Consider the process of adhesion, that is, formation of an interface between two condensed phases (Fig. 2.1). Phases 1 and 2 are being brought under contact in a vacuum or an inert gas, thus forming an interface.

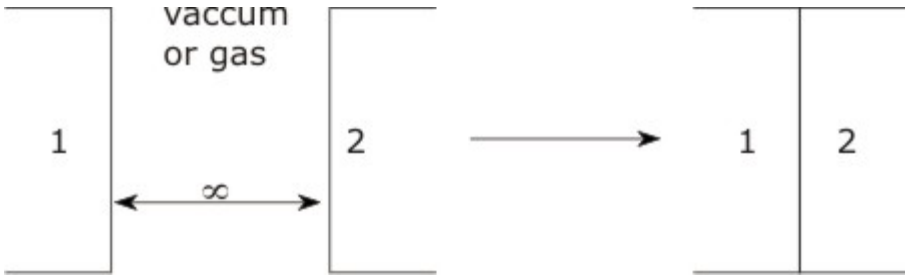

Figure 2.1. Interaction between two surfaces brought in contact in presence of vacuum or gas

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$$\Delta G_{12} = \gamma_{12} - (\gamma_1 + \gamma_2) \quad (2.1)$$

where ΔG_{12} is the change in interfacial energy per unit area between material 1 and 2, γ_{12} is the interfacial tension between materials 1 and 2, and γ_i is the surface tension of material i.

If $\Delta G < 0$, the system is thermodynamically stable, but if $\Delta G > 0$, the process of adhesion is energetically unfavorable.

The above discussion can be generalized for any intervening medium (3), and the following relation can be written

$$\Delta G_{132} = \gamma_{12} - (\gamma_{13} + \gamma_{23}) \quad (2.2)$$

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Note: $\Delta G < 0$, i.e. the fact that adhesion is thermodynamically favorable, does not guarantee that adhesion would occur. Further, whether adhesion is practical can be ascertained if we compare its magnitude to the thermal energy (kT). If it is of the same or lower order then the Brownian motion would overcome the adhesion.

The kinetics of adhesion depends on the details of the energy curve. Even if the change in G predicts adhesion, adhesion might not occur if the barrier to be overcome in bringing the two surfaces in contact is very large. ΔG only tells the change in the energy of the system in going from State 1 to State 2 (Fig. 2.2) but does not take into account the energy barrier to be overcome in going from State 1 to State 2.

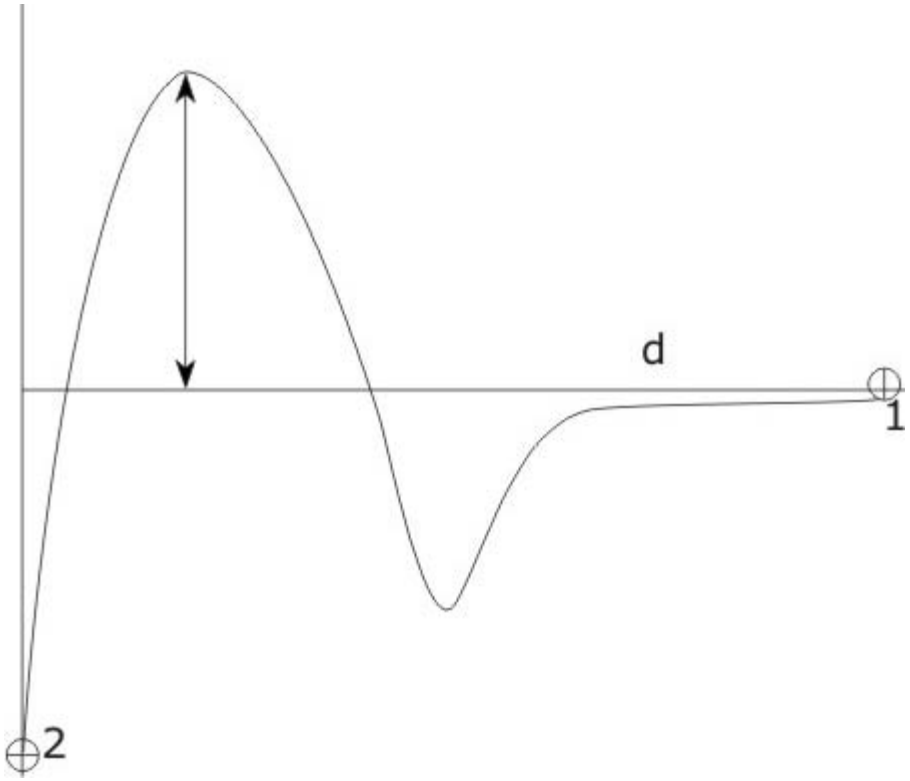

Figure 2.2. Energy curve for an adhesion process

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