

Seminar

Estimation of solid-liquid interfacial tension using curved surface of a soft solid

Animangsu Ghatak

IIT-Kanpur

Surface energy is work necessary to form a unit area of surface by a process of division; and surface tension is the isotropic part of the surface stress. For liquids, molecules are mobile, so that the spacing between them remains unaltered, although the liquid surface area is increased without change in volume. Therefore, the values of surface tension and surface energy remain identical and we do not differentiate between them. It is not so for crystalline solids as the surface tension has been shown to be significantly different from surface energy for several solids both theoretically and experimentally.

Question arises if this effect, known as the Shuttleworth effect, also occurs for amorphous materials like soft cross linked elastomers. In order to resolve this issue we have developed a direct method for measuring solid-liquid interfacial tension by using curved surface of a solid. In essence, we have used the inner surface of tiny cylindrical channels embedded inside a soft elastomeric film for sensing the effect of the interfacial tension. When a liquid is inserted into the channel, because of wetting induced alteration in interfacial tension, its thin wall deflects; the deflection is measured with an optical profilometer and is analysed using the Föppl-von Kármán equation. We have used several liquids and cross linked poly (dimethylsiloxane) as the solid to show that the estimated values of the solid-liquid interfacial tension matches with the corresponding solid-liquid interfacial energy reasonably well. Thus our results signify that unlike crystalline solids, for amorphous, cross linked materials, the surface energy and surface tension remain nearly equal because possibly of the segmental mobility of chains between Crosslinking points.

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4:00 PM (Tea/Coffee at 3:45 PM)

Seminar Hall, TCIS