Equilibrium of Droplets on Deformable Substrate: Influence of Surface Forces and Surface Deformation

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Liquid droplets on deformable/soft substrate may cause the substrate to deform. Surface forces and substrate deformation determine the deformed shape of the substrate and its deformability affects the extent to which the substrate gets deformed. In the present work, the equilibrium of liquid droplets on soft substrates is investigated. Disjoining pressure action in the vicinity of the apparent three phase contact line is taken into account. It is shown that both substrate surface tension and elasticity coefficient along with disjoining pressure action determine the substrate deformation. A simplified linear disjoining pressure isotherm and simple Winkler's model to account for the substrate deformation are used which allows deducing analytical solutions for profiles of both droplet and deformed substrate. It is shown that for higher substrate surface tension there exists a smooth transition in the substrate deformation from the bulk of the droplet to the thin film, but as the substrate surface tension is reduced this smooth transition in the substrate deformation tends to transform into a jump.

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