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Drop equilibrium on charged, elastic surfaces HAOYUAN JING, SHAYANDEV SINHA, SIDDHARTHA DAS, University of Maryland, College Park — A liquid drop equilibrates on a partially-wetting, solid surface by selecting Young's angle as its contact angle. This simple picture gets altered in case the substrate is elastic. The resulting solid deformation ensures that the corresponding contact angle selection necessitates a combined macroscopic and microscopic description with the angles (both macroscopic and microscopic) demonstrating a behavior dictated by the Neumann's Law. Here we theoretically study the role of the presence of surface charges and the corresponding electric double layer (EDL) localized at the drop-soft-solid interface in dictating the corresponding drop equilibrium. This theoretical model, which is capable of quantifying the drop shape on a soft solid for the general case of γ_{sl} not equal to γ_{sv} in a thermodynamically-consistent framework, relies on the properties of the PDMS (polydimethylsiloxane) that has been the most widely used soft solid for quantifying such drop equilibrium. Our results reveal that (a) enhancement in the degree of "softness" ensures that the equilibrium contact angles transit from the EDL-modified Young's law (rigid limit) to the EDL-modified Neumann's law (soft limit), (b) there is an increase in the soft-solid deformation and apparent hydrophilicity of the drop with the EDL effects, and (c) the EDL effects become more significant when the soft solid is more hydrophilic to the drop. All these findings establishes the most remarkable "softness" enhancing capabilities of surface charges in the context of elastocapillarity.

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