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Contact angles on a soft solid: from Young's law to Neumann's law JACCO SNOEIJER, University of Twente, ANTONIN MARCHAND, EPSCI Paris, SIDDHARTHA DAS, University of Alberta, BRUNO ANDREOTTI, EPSCI Paris — The contact angle that a liquid drop makes on a soft substrate does not obey the classical Young's relation, since the solid is deformed elastically by the action of the capillary forces. The finite elasticity of the solid also renders the contact angles different from that predicted by Neumann's law, which applies when the drop is floating on another liquid. Here we derive an elasto-capillary model for contact angles on a soft solid, by coupling a mean-field model for the molecular interactions to elasticity. We demonstrate that the limit of vanishing elastic modulus yields Neumann's law or a slight variation thereof, depending on the force transmission in the solid surface layer. The change in contact angle from the rigid limit (Young) to the soft limit (Neumann) appears when the length scale defined by the ratio of surface tension to elastic modulus γ/E reaches a few molecular sizes.

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