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Describing liquid drops on elastic substrates: Mesoscale model vs. macroscale model and experiment

Tuesday, 6 December 2022 11:30 (30 minutes)

We investigate the behaviour of liquid drops on soft viscoelastic substrates employing mesoscopic and macroscopic models as well as experiments.
First we introduce a simple mesoscopic gradient dynamics model and show that it recovers the known double-transition in contact angles with
increasing softness and that it is well suited to study multi-drop problems like the dependence of drop coarsening on softness [1]. Second, we incorporate the Shuttleworth effect and compare the mesoscopic results with a macroscopic neo-Hookean model with proper treatment of bulk elasticity in a large-deformation framework [2]. Finally, we present experiments showing that condensation of drops on substrates of different softness results in distinctive breath figures / drop ensembles that indicate softness dependent nucleation probabilities. Extending the mesoscopic model to incorporate condensation allows us to predict the dependence of nucleation probability on softness and compare
it with experimental results.
[1] Henkel C., Snoeijer J. H., Thiele U. 2021 Gradient-dynamics model for liquid drops on elastic substrates. Soft Matter 17, 10359–10375, DOI: 10.1039/d1sm01032h
[2] Henkel C., Essink M. H., Hoang T., van Zwieten G. J., van Brummelen E. H., Thiele U., Snoeijer J. H. 2022 Soft wetting with (a)symmetric Shuttleworth effect. Proc. R.
Soc. A 478: 20220132. DOI: 10.1098/rspa.2022.0132

Primary authors: HENKEL, Christopher (Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany); ESSINK, Martin H. (Physics of Fluids Group, Faculty of Science and Technology, Mesa+ Institute, University of Twente, 7500 AE Enschede, The Netherlands); BUILLANT, Ambre (Physics of Fluids Group, Faculty of Science and Technology, Mesa+ Institute, University of Twente, 7500 AE Enschede, The Netherlands); Prof. THIELE, Uwe (Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany); Prof. SNOEIJER, Jacco H. (Physics of Fluids Group, Faculty of Science and Technology, Mesa+ Institute, University of Twente, 7500 AE Enschede, The Netherlands)

Presenters: HENKEL, Christopher (Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany); ESSINK, Martin H. (Physics of Fluids Group, Faculty of Science and Technology, Mesa+ Institute, University of Twente, 7500 AE Enschede, The Netherlands)

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