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Dancing drops on lubricated surfaces

Recently, there is much interest in droplet condensation on soft or liquid or liquidlike substrates. Droplets can deform soft and liquid interfaces resulting in a wealth of phenomena not observed on hard, solid surfaces (e.g., increased nucleation, interdroplet attraction). Here, we describe a unique collective motion of condensate water droplets that emerges spontaneously when a solid substrate is covered with a thin oil film. Droplets move first in a serpentine, self-avoiding fashion before transitioning to circular motions. We show that this self-propulsion (with speeds in the 0.1–1 $\mathrm{mm\,s^{-1}}$ range) is fueled by the interfacial energy release upon merging with newly condensed but much smaller droplets. The resultant collective motion spans multiple length scales from submillimeter to several centimeters, with potentially important heat-transfer and water-harvesting applications.

Hauptautor: LIN, Marcus (King Abdullah University of Science and Technology)

Co-Autoren: Dr. KIM, Philseok (Harvard University); Dr. HARDIAN, Rifan (King Abdullah University of Science and Technology); Dr. ARUNACHALAM, Sankara (King Abdullah University of Science and Technology); Prof. ADERA, Solomon (Harvard University); Prof. AIZENBERG, Joanna (Harvard University); Prof. YAO, Xi (City University of Hong kong); Prof. DANIEL, Dan (King Abdullah University of Science and Technology)

Vortragende(r): LIN, Marcus (King Abdullah University of Science and Technology)