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Light-guided surface plasmonic bubble movement via contact line de-pinning by in-situ deposited plasmonic nanoparticle heating.[1] QIUSHI ZHANG, EUNGKYU LEE, YUNSONG PANG, Department of Aerospace and Mechanical Engineering, University of Notre Dame, 365 Fitzpatrick Hall, Notre Dame, IN 46556, JARROD SCHIFFBAUER, Department of Physics, Colorado Mesa University, Grand Junction, CO, USA, ALEKSANDAR JEMCOV, HSUEH-CHIA CHANG, TENGFEI LUO, Department of Aerospace and Mechanical Engineering, University of Notre Dame, 365 Fitzpatrick Hall, Notre Dame, IN 46556 — Precise spatio-temporal control of surface bubble movement can benefit a wide range of applications like high-throughput drug screening, combinatorial material development, microfluidic logic, colloidal and molecular assembly, etc. In this work, we demonstrate that surface bubbles on a solid surface are directed by a laser to move at high speeds (>1.8 mm/s), and we elucidate the mechanism to be the de-pinning of the three-phase contact line (TPCL) by rapid plasmonic heating of nanoparticles (NPs) deposited in-situ during bubble movement. Based on our observations, we deduce a stick-slip mechanism based on asymmetric fore-aft plasmonic heating: local evaporation at the front TPCL due to plasmonic heating de-pins and extends the front TPCL, followed by the advancement of the trailing TPCL to resume a spherical bubble shape to minimize surface energy. The continuous TPCL drying during bubble movement also enables well-defined contact line deposition of NP clusters along the moving path. Our finding is beneficial to various microfluidics and pattern writing applications.

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