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The Stability of Two-Dimensional Droplets Dragged Across Surfaces DEREK BASSETT, ROGER BONNECAZE, The University of Texas at Austin — The stability of a droplet pressed between a stationary and moving surface is studied theoretically using thin film equations including inertial, capillary and viscous forces. This so-called "drag-a-drop" method has been proposed as a means to suspend a droplet of high index of refraction fluid between a mask blank and lens in a laser mask writing system to greatly enhance the resolution in microelectronic lithographic mask writing. The droplet of fluid is held between the moving lens and the mask due to surface tension forces and must be to stable at high velocities and accelerations. Theoretical calculations show the limits of stability for a two-dimensional droplet. These limits are determined by several factors including the surface energies of the fluid and lens and mask surfaces, the fluid viscosity and density and the thickness of the gap between the cylindrical lens and stationary surface. The droplets are found to breakup by two different mechanisms. In the receding edge instability a thin film pulled behind the lens breaks up into a trail of smaller droplets. In an advancing edge instability, the front edge of the droplet initial shows signs of partial detachment from the lens followed by complete break-up of the attached droplet. A stability map is presented that correlates the onset of these two instabilities as a function of the dimensionless capillary and Weber numbers and compared to our previous experimental measurements.

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