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The Stability of Droplets Dragged Across Surfaces ROGER BONNECAZE, DEREK BASSETT, The University of Texas at Austin — The stability of a droplet pressed between a stationary and moving cylindrical surface is studied experimentally and theoretically. 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 large velocities and accelerations. Experimental measurements and theoretical calculations show that a stable droplet can be held onto a 6 mm diameter lens translating at velocities up to 600 mm/s. The maxima of these stable velocities is 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 break-up 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 number and Weber number.

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