Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Elastohydrodynamics of Step and Flash Imprint Lithography
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— We study theoretically and numerically the elastohydrodynamics of template filling and deformation in Step and Flash Imprint Lithography (SFIL). This is a photolithography process in which the photoresist is compressed in its liquid monomer form between a silicon wafer and a quartz template with desired features. The monomer is cured into the template pattern by flashing UV light through the quartz template, instead of using traditional optical systems. Features as small as 20 nm can be produced with SFIL. Surprisingly, the lubrication pressures in the filling process can be large enough to cause distortions in the template that are comparable to the feature size and hence reduce the fidelity of the imprinting process. An elastohydrodynamic simulation is developed combining lubrication theory with capillary forces for the fluid flow and thin plate theory for the template deformation to understand the dynamics of the process and how to mitigate the undesirable deformation. Imprint time, template deformation and possible contact of the template with the wafer are presented as a function of number of drops, their placement and imprinting speed.

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Date submitted: 03 Aug 2005 Electronic form version 1.4