New 'Liquid Lens' Data for Immersion Lithography

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New data on the properties of potential "liquid lenses" compiled by the National Institute of Standards and Technology (NIST) could help the semiconductor industry continue to shrink feature sizes on computer chips.

In a paper published in the March 10, 2006 issue of *Applied Optics*,* NIST researchers present newly measured values for key properties of organic solvents and inorganic solutions that might be useful in immersion lithography. Little more than an idea three years ago, immersion lithography is already being commercialized, thanks in part to previously published NIST data.

The technique uses liquids to sharpen the focus of patterns used in "printing" semiconductor circuits, much like the eye uses a liquid center to help form images on the retina. Prototype commercial systems use water between the last lens element and the circuit's silicon wafer base, to focus 193-nanometer wavelengths of light down to circuit feature sizes of perhaps 45 nanometers.

The liquids used for immersion lithography must have a high refractive index—the higher the better—which affects how light bends as it crosses interfaces. NIST previously published data on the refractive index of water, which is almost 50 percent higher than that of air. "When we started this work two years ago, you couldn't even find adequate data on water," says Simon Kaplan, lead author of the new paper.

Several companies have proposed proprietary high-index immersion liquids. The NIST work, by contrast, is a fully public report of the key optical properties of a range of fluids. The survey indicates useful trends, such as the fact that refractive index increases with molecular size, and includes data on the effect of temperature on the refractive index, which is crucial in maintaining a sharp focus during the printing process. The data may help other researchers identify useful liquids or calibrate their own measurements.

* S.G. Kaplan and J.H. Burnett. 2006. Optical properties of fluids for 248 nm and 193 nm immersion photolithography. *Applied Optics*. Posted online March 10.

Source: NIST

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