

New photomasks offer cheap chips

Scientists in the US have used a new technique to make complex, 3D microstructures. Albert Folch and colleagues at the University of Washington in Seattle believe that their method could provide an inexpensive alternative to the traditional photolithographic approaches that are currently used to fabricate computer chips and other miniature structures (C Chen *et al.* 2003 *Proc. Natl Acad. Sci.* **100** 1499).

In conventional photolithography, a flat, patterned “photomask” is placed on top of a silicon wafer that has been coated with a light-sensitive layer known as a photoresist. Ultraviolet light is shone through the mask to expose selected parts of the photoresist and chemical etching is then used to “develop” the wafer by removing the unwanted regions of photoresist. This process results in photoresist features that are uniform in height because the UV light exposure is “all-or-none”. The fabrication of 3D structures therefore requires several exposure steps, which is time-consuming and costly. Furthermore, each change in the design of a miniature device requires a new photomask to be made, which slows down the prototype-development process.

To overcome this “all-or-none” limitation, Folch and co-workers made a photomask that allows differing amounts of light to pass through it. The photomask is made from a polymer that is transparent to UV light and contains liquid channels of light-absorbing dyes. The concentrations of dye can be varied to allow more or less light through the system, which enables the researchers to accurately sculpt a 3D photoresist surface. A variety of complex shapes with varying heights, such as wedges and staircases, can be formed in just a few seconds.

The main advantage of the technique is that it allows for an arbitrary number of grey-scales, compared with previous approaches that can only manage a few. It is also cheap – the dyes in the photomask are the same as those used in food colouring. Moreover, the technique offers more versatility in the design of microdevices because the photomask can be reconfigured by simply changing the dye concentration.

Although the method is not fully optimized, the team believes that the photomasks could be used in a wide variety of applications in addition to the fabrication of computer chips. These include micro-optic elements, scaffolds for tissue engineering and other biotechnological applications. The researchers are also interested in combining these devices with living cells, since the polymer from which the photomasks are made is biocompatible.