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Maskless Electron-beam and Optical Lithography

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Mask-based lithography is ideal for high-volume manufacturing because it enables enormous data transfer rates. In manufacturing, the high cost of masks and lithography tools can be amortized over large numbers of products. However, for low-volume manufacturing, research and the exploration of novel applications of lithography, maskless lithography systems have significant cost and convenience advantages. Scanning-electron-beam lithography (SEBL) systems are widely used in research and some low-volume manufacturing. They suffer from well known problems of pattern-placement accuracy, slow writing speed and, in some cases, substrate damage. Strategies for circumventing these problems will be described. A maskless optical-lithography system, called zone-plate-array lithography (ZPAL), has recently been demonstrated that achieves high throughput by the parallel operation of 1000 diffractive-optical lenses [www.lumarray.com]. The performance of ZPAL will be described and compared to SEBL. Also, novel nonlinear strategies for pushing the resolution of ZPAL to feature sizes comparable to those achieved by SEBL will be described.