Parallel scanning near-field photolithography : the snomipede.

Abstract

The “Millipede”, developed by Binnig and co-workers (Bining, G. K.; et al. IBM J. Res. Devel. 2000, 44, 323.), elegantly solves the problem of the serial nature of scanning probe lithography processes, by deploying massive parallelism. Here we fuse the “Millipede” concept with scanning near-field photolithography to yield a “Snomipede” that is capable of executing parallel chemical transformations at high resolution over macroscopic areas. Our prototype has sixteen probes that are separately controllable using a methodology that is, in principle, scalable to much larger arrays. Light beams generated by a spatial modulator or a zone plate array are coupled to arrays of cantilever probes with hollow, pyramidal tips. We demonstrate selective photodeprotection of nitrophenylpropyloxycarbonyl-protected aminosiloxane monolayers on silicon dioxide and subsequent growth of nanostructured polymer brushes by atom-transfer radical polymerization, and the fabrication of 70 nm structures in photoresist by a Snomipede probe array immersed under water. Such approaches offer a powerful means of integrating the top-down and bottom-up fabrication paradigms, facilitating the reactive processing of materials at nanometer resolution over macroscopic areas.

Keyword: Nanolithography; Near-field lithography; Near-field optics; Parallel probe lithography; Scanning probe array; Spatial light modulator.