Sub-100 nm 3D Nanostructuring of Hydrogen Silsesquioxane Resist by 100 keV Electron Beam Lithography

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Electron beam lithography is a very precise method for creating patterns in a layer of material with lateral dimensions down to a few nanometers. Nevertheless, the structuring is usually limited to two-dimensional patterns; three-dimensional (3D) patterning has not been yet fully exploited and is mostly restricted to much larger feature sizes [1-3] of a few hundred of nanometers. Here, we investigate the 3D nanostructring of hydrogen silsesquioxane (HSQ) resist by two-step 100 keV electron beam lithography. Taking advantage of the planarization capabilities of HSQ, two consecutive exposures (including two spin-coating and two development steps) were used to fabricate two-level high aspect ratio structures with lateral dimensions below 50 nm in resist thicknesses of 700—900 nm (figure 1). The samples were developed in a high contrast solution and supercritically dried in carbon dioxide [4]. The 3D HSQ patterning has the potential to produce devices with enhanced performance such as photonic crystals, nanoelectromechanical systems (NEMS) or diffractive X-ray lenses, e.g. Fresnel zone plates (figure 2). The technique can be easily extended to multi-level structuring.

References

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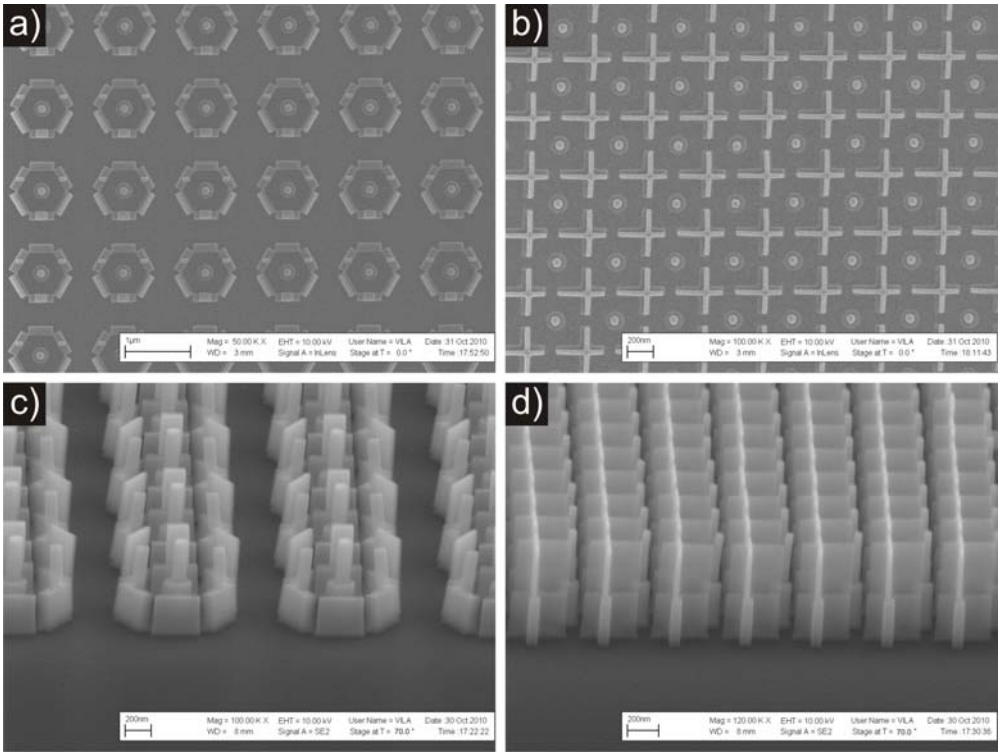

Figure 1: 3D nanostructures made of HSQ with lateral features in the sub-100 nm range in a resist thickness of 800 nm. a), b) top view. c), d) tilted view, 70º.

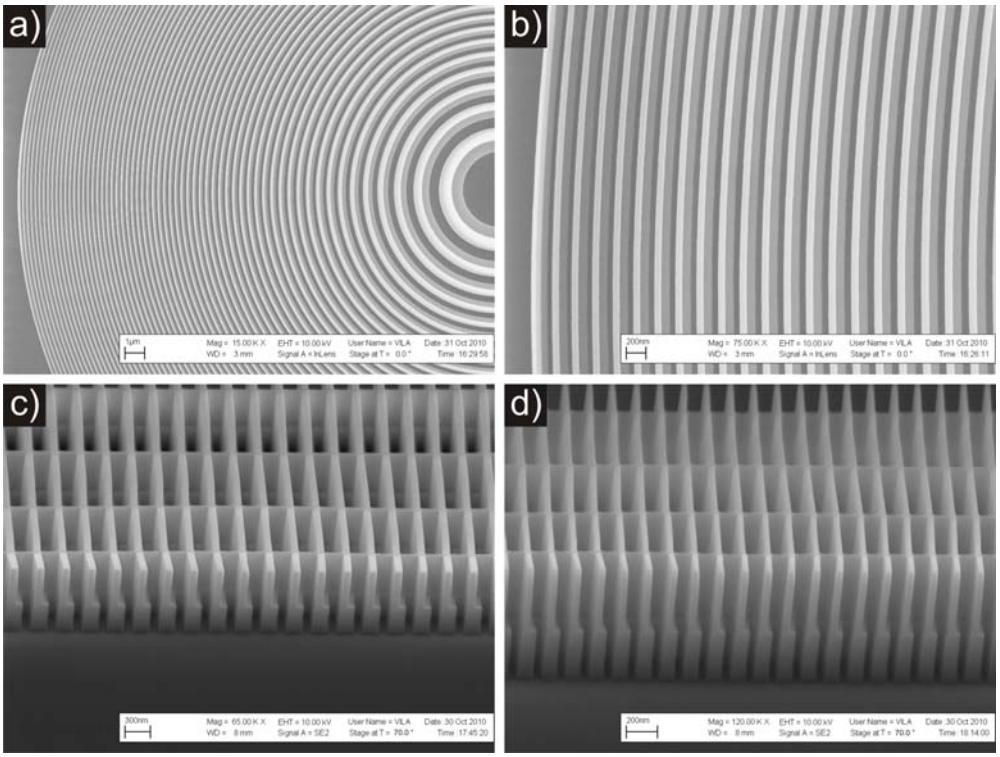

Figure 2: a), b) Top views of a diffractive X-ray lens made of HSQ resist with 300 nm period at the outermost region. c), d) Tilted views of two-level nanostructured line patterns with 300 and 150 nm period (tilt angle of 70º).