



FABRICATION OF PHASE-SHIFTING LITHOGRAPHIC MASKS

Abstract

A phase-shifting lithographic mask (103) is fabricated, in one embodiment, by using a resist layer (13) that is negative tone with respect to a (patterned) electron beam (20) and is positive tone with respect to a (flood) mid-ultraviolet beam, with the tone of the electron beam predominating over that of the mid-ultraviolet beam. The resist layer is spun on a body comprising a patterned metallic layer (11) located on a (transparent) quartz slab (10). The body is subjected from below to a flood mid-ultraviolet beam (30) and from above to the patterned electron beam whose edges are located somewhere in the midst of the patterned opaque layer but are not coincident with any edges of the patterned opaque layer. Thus, a subsequent development of the resist layer removes those regions and only those regions of the resist layer upon which the ultraviolet beam was incident--i.e., not in the shadows cast by the patterned opaque layer--in the absence of incidence of the patterned electron beam. Then, an anisotropic etching removes to a prescribed depth the portions (15) of the (transparent) substrate not covered by the remaining (patterned) resist layer (14). In other embodiments, the (patterned) electron beam is replaced by a (patterned) deep ultraviolet beam. In still other embodiments the same radiation (wavelength) can be used for the patterned beam as for the flood radiation in conjunction with a resist layer whose tone can be reversed by an intermediate processing step between irradiations with the patterned and flood beams, respectively.