Embedded Etch Stop for Phase Shift Masks and Planar Phase Shift Masks to Reduce Topography Induced and Wave Guide Effects

ABSTRACT

Attenuating phase shift masks and alternating phase shift masks provide increased resolution of the apparatus by introducing a phase shift in the radiation transmitted between adjacent features of the pattern on the mask. A phase shift mask is provided with a layer of inorganic material that is etchable. The inorganic material layer is formed on a mask blank having a glass or quartz layer and an etch stop layer. The etch stop layer provides uniform etch depth of the pattern in the inorganic material layer as the etch stop layer is formed of a material that is not etched by the etching process. The phase shift mask may be provided with a layer of attenuating material instead of the resinous inorganic polymer layer. The features of the pattern of the phase shift mask may also be filled with an optically transparent or translucent material or with an opaque material having an index of refraction and a dielectric constant selected to reduce the boundary effect at side walls of features of the pattern. A device for use in an integrated circuit, an integrated optical system, magnetic domain memories, liquid-crystal display panels, and thin-film magnetic heads may be manufactured by exposing a radiation sensitive material on a substrate to a projection beam of radiation patterned with a phase shift mask having an etch stop layer and/or a pattern filled with optically transparent or translucent material or with an opaque material.

Fig. 4