Claims

1. A manufacturing method of a master template (20) of a grating of a diffractive optic element, c h a r a c t e r i z e d by

depositing (800), on hard mask (190) of a substrate (108) of the master template (20), at least one layer (250) of material (200) through perforations (204) of a plate (202), cross sectional areas of the perforations (204) depending on locations of the perforations (204) in the plate (202), and the plate (202) and the substrate (108) being spaced at a non-zero distance (D) from each other;

causing (802) height of the at least one layer (250) on the substrate (108) to vary with variation of the areas of the perforations (204);

forming (804) raised formations (180) on the substrate (108) by removing the at least one layer (250) from areas, which results in lowered formations (182) between the raised formations (180), wherein the hardmask (190) acts as an etch stop layer configured to stop an etching process of the at least one layer (250) at a surface of the hardmask (190) and protect the substrate (108) from etching when the at least one layer (250) is etched through at the lowered formations (182); and

making (806) a fill factor and height of the raised formations (180) to be proportional with each other while the raised and lowered formations (180, 182) have a relation with grooves (902) and ridges (900) of the grating (904), the relation depending on the proportionality.

2. The manufacturing method of claim 1, c h a r a c t e r i z e d by

making the fill factor and the height of the raised formations (180) to be directly proportional with each other; and

making the raised formations (180) and the lowered formations (182) to correspond with the grooves (902) and the ridges (900) of the grating (904), respectively.

3. The manufacturing method of claim 1, c h a r a c t e r i z e d by

making the fill factor and the height of the raised formations (180) to be inversely proportional with each other;

making the raised and lowered formations (180, 182) to correspond with the ridges (900) and the grooves (902) of the grating (904), respectively.

4. The manufacturing method of claim 2 or 3, c h a r a c t e r i z e d by

copying the raised and lowered formations (180, 182) in an inversed manner for inversing the height profile and fill factor, and the inversed copy of the raised and lowered formations (180, 182) being configured to correspond to distribution and sizes of the grooves (902) and the ridges (900) of the grating (904).

5. The manufacturing method of claim 4, c h a r a c t e r i z e d by forming a copy of the master template (20) by copying the raised and lowered formations (180, 182) in the inversed manner by pressing the raised and lowered formations (180, 182) of the master template (20) against polymer (184); and making the copy of the master template (20) to comprise the inversely copied raised and lowered formations (180, 182) of the master template (20).

6. The manufacturing method of claim 1, c h a r a c t e r i z e d by performing depositing of the layer (250) by at least one of the following: sputtering, chemical vapor deposition and physical vapor deposition.

7. The manufacturing method of claim 1, c h a r a c t e r i z e d by forming (804) the raised formations (180) on the substrate (108) by removing solid material (200) of the layer (250) from the substrate (108) at locations that correspond with locations of the ridges (900) of the grating (904).

8. The manufacturing method of claim 1, c h a r a c t e r i z e d by making the height of the layer (250) to vary in two dimensions based on corresponding variation of the areas of the perforations (204) in two dimensions.

9. A manufacturing method of a stamp (22) of a grating of a diffractive optic element, c h a r a c t e r i z e d by making a master template (20) by

depositing (800), on a hardmask (190) of a substrate (108) of the template (20), at least one layer (250) of a material (200) through perforations (204) of a plate (202), cross sectional areas of the perforations (204) depending on locations of the perforations (204) in the plate (202), and the plate (202) and the substrate (108) being spaced at a non-zero distance (D) from each other;

causing (802) height of the at least one layer (250) on the substrate (108) to vary with variation of the cross sectional areas of the perforations (204);

forming (804) raised formations (180) on the substrate (108) by removing the at least one layer (250) from areas, which results in lowered formations (182) between the raised formations (180), wherein the hardmask (190) acts as an etch stop layer configured to stop an etching process of the at least one layer (250) at a surface of the hardmask (190) and protect the substrate (108) from etching when the at least one layer (250) is etched through at the lowered formations (182);

making (806) a fill factor and a height of the raised formations (180) to be proportional with each other while the raised and lowered formations (180, 182) have a relation with grooves (902) and ridges (900) of the grating (904), the relation depending on the proportionality; and for the stamp (22):

replicating (808) the master template (20) M times based on a profile inversing process, where M is an odd number, in response to the fill factor and the height of the raised formations (180) being inversely proportional with each other, or

forming (810) the stamp (22) from the master template (20) without a replication process in response to the fill factor and the height of the raised formations (180) being directly proportional with each other, or by replicating the master template (20) N times based on a profile inversing process, where N is an even number, in response to the fill factor and the height of the raised formations (180) being directly proportional with each other.

10. A manufacturing method of a diffractive optic element, c h a r a c t e r i z e d by

forming (1000), with a stamp (22) manufactured according to claim 9 and having the fill factor and the height of the raised formations (180) directly proportional with each other, a fill factor and height of elevated formations (180') to a polymer (184) on the hardmask (190) of a preform (188) of the diffractive optic element, the fill factor and the height of the elevated formations (180') of the preform (188) being inverse to the fill factor and the height of the raised formations (180) of the stamp (22);

removing (1002) a residual layer (186) from between the elevated formations (180'); and

making (1004) ridges (900) to a grating layer (192), which is on a lightguide (194) of the preform (188), the ridges (900) resulting in at locations corresponding to locations of the lowered formations (182) of the stamp (22).

11. The manufacturing method of claim 10, c h a r a c t e r i z e d by causing (1006) the residual layer (186) of the polymer (184) to have a substantially constant height based on the fill factor with the stamp (22) and the height of the raised formations (180) of the stamp (22) that are directly proportional with each other.

12. A master template (20) for manufacturing a diffractive optic element, c h a r a c t e r i z e d in that

a substrate (108) is covered with a hardmask (190),

the hardmask (190) being partially covered with material layer (250) of solid material (200) forming the raised formations (180) and the lowered formations (182), the hardmask (190) protects of the substrate (108) when the layer (250) of the solid material (200) is removed for forming the lowered formations (182), the hardmask (190) being configured to stop the etching process of a layer (250) at the hardmask (190) and protect of the substrate (108) from etching,

a fill factor and height of raised formations (180) of the master template (20) are proportional with each other, and the raised formations 180) and lowered formations (182) of the layer (250) have a determined relation with grooves (902)

and ridges (900) of grating (904), the determined relation depending on said proportionality.

13. The master plate of claim 12, c h a r a c t e r i z e d in that the fill factor and the height of the raised formations (180) of the master template (20) are directly proportional with each other, and the raised formations (180) are configured to cause the grooves (902) of the grating (904) and the lowered formations (182) are configured to cause the ridges (900) of the grating (904).

14. The master plate of claim 12, c h a r a c t e r i z e d in that the fill factor and the height of the raised formations (180) of the master template (20) are inversely proportional with each other, and the raised formations (180) are configured to cause the ridges (900) of the grating (904) and the lowered formations (182) are configured to cause the grooves (900) of the grating (904).