CLAIMS

1. A method of etching trenches into silicon of a semiconductor substrate, comprising:

forming a mask over silicon of a semiconductor substrate, the mask comprising trenches formed there-through; and

plasma etching trenches into the silicon of the semiconductor substrate using the mask, the plasma etching comprising forming an etching plasma using precursor gases comprising SF_6, an oxygen-containing compound, and a nitrogen-containing compound.

2. The method of claim 1 wherein the oxygen-containing compound and the nitrogen-containing compound comprise different compounds.

3. The method of claim 1 wherein the oxygen-containing compound and the nitrogen-containing compound comprise the same compound.

4. The method of claim 3 wherein the same compound comprises NO_x.

5. The method of claim 1 wherein the precursor gases comprise HBr.

6. The method of claim 1 wherein the mask comprises an outermost hardmask layer during at least a latter portion of the plasma etching into the silicon, said outermost hardmask layer being void of carbon.

7. The method of claim 1 wherein the nitrogen-comprising compound comprises N_2.

8. The method of claim 7 wherein the precursor gases comprise HBr.

9. The method of claim 1 wherein the precursor gases comprise two oxygen-containing compounds, one of the oxygen compounds being void of nitrogen, another of the oxygen-containing compounds comprising the nitrogen-containing compound.

10. The method of claim 9 wherein the one comprises O_2 and the another comprise NO_x.

11. A method of etching trenches into silicon of a semiconductor substrate, comprising:

forming a mask over silicon of a semiconductor substrate, the mask comprising trenches formed there-through; and

plasma etching trenches into the silicon of the semiconductor substrate using the mask, the plasma etching comprising an etching plasma comprising a sulfur-containing component, an oxygen-containing component, and NF_x.

12. The method of claim 11 the sulfur of the sulfur-containing component is formed from a precursor gas comprising SF_6.

13. The method of claim 11 wherein the oxygen of the oxygen-containing component is formed from a precursor gas comprising O_2, and the nitrogen of the NF_x is formed from a precursor gas compound which is void of oxygen.

14. The method of claim 11 wherein the oxygen of the oxygen-containing component and the nitrogen of the NF_x are formed from a precursor gas comprising NO_x.

15. The method of claim 11 wherein a layer of pad oxide is present between the hardmask and the silicon of the semiconductor substrate.

16. The method of claim 11 wherein a layer of silicon nitride is present between the hardmask and the silicon of the semiconductor substrate.

17. The method of claim 11 wherein a layer of polysilicon is present between the hardmask and the silicon of the semiconductor substrate.

18. The method of claim 11 wherein the etching plasma is formed by flowing the sulfur component at a flow rate of about 1 sccm to about 100 sccm, flowing the oxygen component at from about 10 sccm to about 500 sccm and flowing a nitrogen component at from about 1 sccm to about 500 sccm.

The invention claimed is:

1. A method of etching trenches into silicon of a semiconductor substrate, comprising:

forming a mask over silicon of a semiconductor substrate, the mask comprising trenches formed there-through; and

plasma etching tapered trenches into the silicon of the semiconductor substrate using the mask, the trenches passing through at least two differently doped silicon layers, the plasma etching comprising forming an etching plasma using precursor gases consisting of SF_6, an oxygen-containing compound, a nitrogen-containing compound and optionally HBr.

2. The method of claim 1 wherein the oxygen-containing compound and the nitrogen-containing compound are different compounds.

3. The method of claim 1 wherein HBr is present in the precursor gases.

4. The method of claim 1 wherein the mask comprises an outermost hardmask layer during at least a latter portion of the plasma etching into the silicon, said outermost hardmask layer being void of carbon.

5. The method of claim 1 wherein the nitrogen-containing compound is N_2.

6. The method of claim 5 wherein HBr is present in the precursor gases.