

CLAIMS

1. A method for forming polysilicon on a surface of an insulator layer or of a semiconductor substrate comprising:
 - providing an amorphous silicon layer on said surface of the insulator layer or semiconductor substrate, defining an interface between said amorphous silicon layer and said insulator layer or semiconductor substrate;
 - a first step of exposing at least an area of the amorphous silicon layer to a first laser beam and a second step of exposing said area to a second laser beam,
 - wherein during exposing the area to the second laser beam no displacement of the laser beam relative to the area occurs, and wherein:
 - during the first step, the energy density and/or pulse duration generated by the first laser beam is selected to fully melt the amorphous silicon layer up to said interface, and so as to form by recrystallization a polysilicon layer with relatively small polysilicon grains,
 - and during the second step, the energy density and/or pulse duration generated by the second laser beam is lower than the energy density and/or, respectively, pulse duration generated by the first laser beam, the energy density and/or pulse duration generated by the second laser beam being selected to partially melt the polysilicon grains formed by the first laser beam, and so as to enhance growth and solidification of relatively larger grain polysilicon with grain sizes of more than 1 micrometer in a direction perpendicular to the surface of the insulator layer or semiconductor substrate.
2. The method according to claim 1, wherein the melt depth generated by the second laser beam is smaller than the melt depth generated by the first laser beam.
3. The method according to claim 1, wherein the energy density generated by the second laser beam is lower than the energy density generated by the first laser beam.

4. The method according to claim 1, wherein the amorphous silicon is provided on top of an insulator layer thereby defining an interface, and wherein the energy density generated by the first laser beam is sufficient for melting the amorphous silicon up to the amorphous silicon-insulator interface.
5. The method according to claim 1, wherein the first and second laser beam are generated by the same laser source.
6. The method according to claim 1, wherein during laser annealing the semiconductor substrate is kept at room temperature.
7. The method according to claim 1, wherein a plurality of areas of the amorphous silicon layer are first exposed to the first laser beam and wherein each of the plurality of areas is subsequently exposed to the second laser beam.
8. A method for producing large-grain polysilicon with grain sizes of least 1 micrometer in a direction perpendicular to a surface of an insulator layer or semiconductor substrate, comprising forming polysilicon on the surface of the insulator layer or semiconductor substrate according to the method of claim 1.
9. A method for producing vertical grain polysilicon extended in a direction perpendicular to a surface of an insulator layer or semiconductor substrate, comprising forming polysilicon on the surface of the insulator layer or semiconductor substrate according to the method of claim 1.
10. A method for producing sensors, MEMS, NEMS, Non Volatile Memory, Volatile memory, NAND Flash, DRAM, Poly Si contacts and interconnects, comprising forming polysilicon on a surface of an insulator layer or semiconductor substrate according to the method of claim 1.
11. The method according to claim 3, wherein the amorphous silicon is provided on top of an insulator layer thereby defining an interface, and wherein the energy density generated by the first laser beam is sufficient for melting the amorphous silicon up to the amorphous silicon-insulator interface.

12. The method according to claim 3, wherein the first and second laser beam are generated by the same laser source.

13. The method according to claim 3, wherein during laser annealing the semiconductor substrate is kept at room temperature.

14. The method according to claim 3, wherein a plurality of areas of the amorphous silicon layer are first exposed to the first laser beam and wherein each of the plurality of areas is subsequently exposed to the second laser beam.

15. The method according to claim 4, wherein the first and second laser beam are generated by the same laser source.

16. The method according to claim 4, wherein during laser annealing the semiconductor substrate is kept at room temperature.

17. The method according to claim 4, wherein a plurality of areas of the amorphous silicon layer are first exposed to the first laser beam and wherein each of the plurality of areas is subsequently exposed to the second laser beam.

18. The method according to claim 5, wherein during laser annealing the semiconductor substrate is kept at room temperature.

19. The method according to claim 5, wherein a plurality of areas of the amorphous silicon layer are first exposed to the first laser beam and wherein each of the plurality of areas is subsequently exposed to the second laser beam.

20. The method according to claim 6, wherein a plurality of areas of the amorphous silicon layer are first exposed to the first laser beam and wherein each of the plurality of areas is subsequently exposed to the second laser beam.