CLAIMS

1. A capacitive coupled electrodeless plasma apparatus for processing a silicon substrate, wherein capacitive coupled refers to a potential drop across at least one inductive antenna comprised in the apparatus and wherein electrodeless refers to an absence of electrodes in the plasma generated in a chamber of the apparatus, the apparatus including:

the at least one inductive antenna driven by time-varying power sources for providing at least one electrostatic field, the at least one inductive antenna being configured to enable control of ion motion parallel to a surface of the silicon substrate; and

the chamber for locating the silicon substrate,

wherein the at least one electrostatic field induced by the potential drop across the at least one inductive antenna is for breakdown of feedstock gases and sustenance of discharge in the chamber.

2. The apparatus of claim 1, wherein the chamber is for placement of the at least one inductive antenna with isolation of the inductive antenna being enabled using at least one dielectric window.

3. The apparatus of claim 2, wherein the inductive antenna is in a configuration selected from a group consisting of: planar spiral configuration, cylindrical configuration and coil configuration.

4. The apparatus of claim 1, wherein a potential drop across the inductive antenna is dependent on both an inductance of the antenna and a frequency of RF power.

5. The apparatus of claim 1, wherein the silicon substrate is set at a floating potential to reduce ion energy.

6. The apparatus of claim 1, wherein the silicon substrate is of either a single-crystalline or a multi-crystalline form.

7. The apparatus of claim 1, wherein the silicon substrate is processed in a manner selected from a group consisting of: deposition of at least one thin film, etching and modification of surface morphology, and etching and modification of surface properties.

8. The apparatus of claim 7, wherein the deposition of at least one thin film can be:
carried out on at least one side of the substrate;
carried out at room temperature;
carried out with post thermal activation treatment of < 400^{o}C;
carried out with annealing time of < 1 hour; or
carried out using any combination of the aforementioned.

9. The apparatus of claim 1, wherein a frequency of the time-varying power sources is 500 kHz.

10. A method for processing a silicon substrate using a capacitive coupled electrodeless plasma apparatus, wherein “capacitive coupled” refers to a potential drop across at least one inductive antenna comprised in the apparatus and wherein “electrodeless” refers to an absence of electrodes in a plasma generated in a chamber of the apparatus, the method comprising:
locating the silicon substrate in the chamber;
providing at least one electric field using the at least one inductive antenna driven by time-varying power sources; and
selecting a configuration of the at least one inductive antenna to enable control of ion motion parallel to a surface of the silicon substrate;
wherein the at least one electric field induced by a potential drop across the at least one inductive antenna is for breakdown of feedstock gases and sustenance of discharge in the chamber; and
wherein the time-varying power sources are operated up to an upper limit such that an electron density of the discharge is of an order of magnitude of $10^{9} – 10^{11}$ cm^{-3}.

11. The method of claim 10, further including setting the silicon substrate at a floating potential.

12. The method of claim 10, wherein the silicon substrate is processed in a manner selected from a group consisting of: deposition of at least one thin film, etching and modification of surface morphology, and etching and modification of surface properties.

13. The method of claim 12, wherein the deposition of at least one thin film can be:
carried out on at least one side of the substrate;
carried out at room temperature;
carried out with post thermal activation treatment of < 400°C;

carried out with annealing time of < 1 hour; or

carried out using any combination of the aforementioned.

14. The method of claim 10, wherein a frequency of the time-varying power sources is 500 kHz.