CLAIMS

1. A plasma processing system having a plasma processing chamber for processing a substrate, said plasma processing chamber comprising:

an upper electrode, said upper electrode having a first upper electrode portion and a second upper electrode portion, said first upper electrode portion annularly surrounds said second upper electrode portion;

a lower electrode, said lower electrode having a first lower electrode portion and a second lower electrode portion, said first lower electrode portion annularly surrounds said second lower electrode portion, said second lower electrode portion having a substrate bearing surface configured to support said substrate during said processing, wherein at least one of said upper electrode and said lower electrode is movable in a direction that is perpendicular to said substrate bearing surface, wherein an upper surface of said first lower electrode portion is non-planar with respect to said substrate-bearing surface such that a first gap between said upper surface of said first lower electrode portion and a lower surface of said first upper electrode portion is smaller than a second gap between said substrate bearing surface and a substrate-facing surface of said second upper electrode portion, wherein said second lower electrode portion is powered by a radio frequency (RF) power source during said processing,

wherein said plasma processing chamber is configured to be operable during at least two regimes, a first regime of said two regimes involving disposing said upper electrode and said lower electrode such that plasma is sustained between said substrate bearing surface of said second lower electrode portion and said substrate-facing surface of said second upper electrode portion, said plasma is also sustained in said first regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion, a second regime of said two regimes involving disposing said upper electrode and said lower electrode such that said plasma is sustained between said substrate bearing surface of said second lower electrode portion and a substrate-facing surface of said second upper electrode portion, said plasma is however not sustained in said second regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion, an

area ratio of RF coupling between said upper electrode and said lower electrode is about 1:1 in said second regime.

2. The plasma processing system of claim 1 wherein only said upper electrode is movable.

3. The plasma processing system of claim 1 wherein only said lower electrode is movable.

4. The plasma processing system of claim 1 wherein both said upper electrode and said lower electrode are movable.

5. The plasma processing system of claim 1 wherein said lower surface of said first upper electrode portion is planar with respect to said substrate-facing surface of said second upper electrode portion.

6. The plasma processing system of claim 1 wherein said lower surface of said first upper electrode portion is non-planar with respect to said substrate-facing surface of said second upper electrode portion.

7. A plasma processing system having a plasma processing chamber for processing a substrate, said plasma processing chamber comprising:

an upper electrode, said upper electrode having a first upper electrode portion and a second upper electrode portion, said first upper electrode portion annularly surrounds said second upper electrode portion, both said first upper electrode portion and said second upper electrode portion being grounded during said processing;

a lower electrode, said lower electrode having a first lower electrode portion and a second lower electrode portion, said first lower electrode portion being grounded and being electrically separated from and annularly surrounding said second lower electrode portion, said second lower electrode portion having a substrate bearing surface configured to support said substrate during said processing, wherein said upper

electrode is movable in a direction that is perpendicular to said substrate bearing surface;

a RF power source for providing RF energy to said second lower electrode portion, wherein an upper surface of said first lower electrode portion is non-planar with respect to said substrate-bearing surface such that a first gap between said upper surface of said first lower electrode portion and a lower surface of said first upper electrode portion is smaller than a second gap between said substrate bearing surface and a substrate-facing surface of said second upper electrode portion.

8. The plasma processing system of claim 7 wherein both said upper electrode and said lower electrode are movable in said direction that is perpendicular to said substrate bearing surface.

9. The plasma processing system of claim 7 wherein said lower surface of said first upper electrode portion is planar with respect to said substrate-facing surface of said second upper electrode portion.

10. The plasma processing system of claim 7 wherein said lower surface of said first upper electrode portion is non-planar with respect to said substrate-facing surface of said second upper electrode portion.

11. The plasma processing system of claim 7 wherein said plasma processing chamber is configured to be operable during at least two regimes, a first regime of said two regimes involving disposing said upper electrode and said lower electrode such that plasma is sustained between said substrate bearing surface of said second lower electrode portion and said substrate-facing surface of said second upper electrode portion, said plasma is also sustained in said first regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion, said second regime of said two regimes involving disposing said upper electrode and said lower electrode such that said plasma is sustained between said substrate bearing surface of said second lower electrode portion and a substrate-facing surface of said second upper electrode portion, said plasma is however not sustained in

said second regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion.

12. The plasma processing system of claim 7 wherein an area ratio of RF coupling between said upper electrode and said lower electrode is about 1:1 in said second regime.

CLAIMS

What is claimed is:

1. A plasma processing system having a plasma processing chamber for processing a substrate, said plasma processing chamber comprising

an upper electrode, said upper electrode having a first upper electrode portion and a second upper electrode portion, said first upper electrode portion annularly surrounds said second upper electrode portion, both said first upper electrode portion and said second upper electrode portion being grounded during said processing;

a lower electrode, said lower electrode having a first lower electrode portion and a second lower electrode portion, said first lower electrode portion being grounded and annularly surrounds said second lower electrode portion, said second lower electrode portion having a substrate bearing surface configured to support said substrate during said processing, wherein at least one of said upper electrode and said lower electrode is movable in a direction that is perpendicular to said substrate bearing surface;

a RF power source for providing RF energy to said second lower electrode portion, wherein an upper surface of said first lower electrode portion is non-plannar with respect to said substrate-bearing surface such that a first gap between said upper surface of said first lower electrode portion and a lower surface of said first upper electrode portion is smaller than a second gap between said substrate bearing surface and a substrate-facing surface of said second upper electrode portion.

2. The plasma processing system of claim 1 wherein only said upper electrode is movable.

3. The plasma processing system of claim 1 wherein only said lower electrode is movable.

4. The plasma processing system of claim 1 wherein both said upper electrode and said lower electrode are movable.

5. The plasma processing system of claim 1 wherein said lower surface of said first upper electrode portion is planar with respect to said substrate-facing surface of said second upper electrode portion.

6. The plasma processing system of claim 1 wherein said lower surface of said first upper electrode portion is non-planar with respect to said substrate-facing surface of said second upper electrode portion.

7. The plasma processing system of claim 1 wherein said plasma processing chamber is configured to be operable during at least two regimes, a first regime of said two regimes

involving disposing said upper electrode and said lower electrode such that plasma is sustained between said substrate bearing surface of said second lower electrode portion and said substrate-facing surface of said second upper electrode portion, said plasma is also sustained in said first regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion, said second regime of said two regimes involving disposing said upper electrode and said lower electrode such that said plasma is sustained between said substrate bearing surface of said second lower electrode portion and a substrate-facing surface of said second upper electrode portion, said plasma is however not sustained in said second regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion.

8. The plasma processing system of claim 1 wherein a ratio area of RF coupling is about 1:1 in said second regime.

9. A plasma processing system having a plasma processing chamber for processing a substrate, said plasma processing chamber comprising

an upper electrode, said upper electrode having a first upper electrode portion and a second upper electrode portion, said first upper electrode portion annularly surrounds said second upper electrode portion, both said first upper electrode portion and said second upper electrode portion being grounded during said processing;

a lower electrode, said lower electrode having a first lower electrode portion and a second lower electrode portion, said first lower electrode portion being grounded and annularly surrounds said second lower electrode portion, said second lower electrode portion having a substrate bearing surface configured to support said substrate during said processing, wherein at least one of said upper electrode and said lower electrode is movable in a direction that is perpendicular to said substrate bearing surface;

a RF power source for providing RF energy to said second lower electrode portion, wherein a lower surface of said first upper electrode portion is non-planar with a substrate-facing surface of said second upper electrode portion such that a first gap between said lower surface of said first upper electrode portion and an upper surface of said first lower electrode portion is smaller than a second gap between said substrate bearing surface and said substrate-facing surface of said second upper electrode portion.

10. The plasma processing system of claim 9 wherein only said upper electrode is movable.

11. The plasma processing system of claim 9 wherein only said lower electrode is movable.

12. The plasma processing system of claim 9 wherein both said upper electrode and said lower electrode are movable.

13. The plasma processing system of claim 9 wherein said upper surface of said first lower electrode portion is planar with respect to said substrate-bearing surface of said second lower electrode portion.

14. The plasma processing system of claim 9 wherein said upper surface of said first lower electrode portion is non-planar with respect to said substrate-bearing surface of said second lower electrode portion.

15. The plasma processing system of claim 9 wherein said plasma processing chamber is configured to be operable during at least two regimes, a first regime of said two regimes involving disposing said upper electrode and said lower electrode such that plasma is sustained between said substrate bearing surface and said substrate-facing surface of said second upper electrode portion, said plasma is also sustained in said first regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion, said second regime of said two regimes involving disposing said upper electrode and said lower electrode such that plasma is sustained between said substrate bearing surface and a substrate-facing surface of said second upper electrode portion, said plasma is however not sustained in said second regime between said upper surface of said first lower electrode portion and said lower surface of said first upper electrode portion.

16. The plasma processing system of claim 9 wherein a ratio area of RF coupling is about 1:1 in said second regime.

17. A method for processing a substrate in a plasma processing system having a plasma processing chamber for processing a substrate, said method comprising

disposing said substrate on a substrate-bearing surface of a lower electrode of said plasma processing chamber;

processing said plasma processing chamber in a first regime;

processing said plasma processing in a second regime that is different from said first regime, said first regime involving a first ratio area of RF coupling, said second regime involving a second ratio area of RF coupling different from said first ratio area of RF coupling, said plasma processing chamber transitions between said first regime and said second regime at least partially by moving one of an upper electrode and a lower electrode in a direction perpendicular to said substrate bearing surface.

18. The method of claim 17 wherein said upper electrode has a first upper electrode portion and a second upper electrode portion, said first upper electrode portion annularly

surrounds said second upper electrode portion, both said first upper electrode portion and said second upper electrode portion being grounded during said processing, said lower electrode has a first lower electrode portion and a second lower electrode portion, said first lower electrode portion being grounded and annularly surrounds said second lower electrode portion, said second lower electrode portion having said substrate bearing surface configured to support said substrate during said processing; wherein a lower surface of said first upper electrode portion is non-planar with a substrate-facing surface of said second upper electrode portion such that a first gap between said lower surface of said first upper electrode portion and an upper surface of said first lower electrode portion is smaller than a second gap between said substrate bearing surface and said substrate-facing surface of said second upper electrode portion.

19. The method of claim 17 wherein said upper electrode has a first upper electrode portion and a second upper electrode portion, said first upper electrode portion annularly surrounds said second upper electrode portion, both said first upper electrode portion and said second upper electrode portion being grounded during said processing, said lower electrode has a first lower electrode portion and a second lower electrode portion, said first lower electrode portion being grounded and annularly surrounds said second lower electrode portion, said second lower electrode portion having said substrate bearing surface configured to support said substrate during said processing; wherein an upper surface of said first lower electrode portion is non-planar with said substrate-bearing surface of said second lower electrode portion such that a first gap between said upper surface of said first lower electrode portion and a lower surface of said first upper electrode portion is smaller than a second gap between said substrate bearing surface and said substrate-facing surface of said second upper electrode portion.

20. The method of claim 17 wherein only said lower electrode is movable.