CLAIMS

1. A substrate support assembly, comprising:

an electrostatic chuck body defining a substrate support surface that defines a substrate seat;

a support stem coupled with the electrostatic chuck body;

a heater embedded within the electrostatic chuck body;

a first bipolar electrode embedded within the electrostatic chuck body between the heater and the substrate support surface;

a second bipolar electrode embedded within the electrostatic chuck body between the heater and the substrate support surface;

at least one inner capacitive sensor embedded within the electrostatic chuck body at a position proximate a center of the substrate seat; and

at least one outer capacitive sensor embedded within the electrostatic chuck body at a position proximate a peripheral edge of the substrate seat, wherein each of the at least one inner capacitive sensor and the at least one outer capacitive sensor comprises a negative electrode and a positive electrode with the negative electrode positioned adjacent to the positive electrode within the electrostatic chuck body.

2. The substrate support assembly of claim 1, wherein:

each of the at least one inner capacitive sensor and the at least one outer capacitive sensor is disposed between a surface of the substrate seat and a top surface of one or both of the first bipolar electrode and the second bipolar electrode.

3. The substrate support assembly of claim 1, wherein:

the at least one outer capacitive sensor comprises a plurality of outer capacitive sensors disposed about the peripheral edge of the substrate seat.

4. The substrate support assembly of claim 3, wherein:

at least two of the plurality of outer capacitive sensors are disposed at equal radial distances from a center of the substrate seat.

5. The substrate support assembly of claim 3, wherein:

the plurality of outer capacitive sensors are disposed at equal angular intervals about the peripheral edge of the substrate seat.

6. The substrate support assembly of claim 1, further comprising:

an AC voltage supply coupled with each of the at least one inner capacitive sensor and the at least one outer capacitive sensor.

7. A substrate support assembly, comprising:

a chuck body defining a substrate support surface that defines a substrate seat;

a support stem coupled with the chuck body;

a heater embedded within the chuck body;

a chucking mechanism disposed within the chuck body between the heater and the substrate support surface;

at least one inner capacitive sensor embedded within the chuck body at a position proximate a center of the substrate seat; and

a plurality of outer capacitive sensors embedded within the chuck body at positions proximate a peripheral edge of the substrate seat, wherein each of the at least one inner capacitive sensor and the plurality of outer capacitive sensors comprises a negative electrode and a positive electrode with the negative electrode positioned adjacent to the positive electrode within the chuck body.

8. The substrate support assembly of claim 7, wherein:

at least two of the plurality of outer capacitive sensors are spaced at equal radial distances from a center of the substrate seat.

9. The substrate support assembly of claim 7, further comprising:

an AC voltage supply coupled with each of the at least one inner capacitive sensor and the plurality of outer capacitive sensors.

10. The substrate support assembly of claim 7, wherein:

the plurality of outer capacitive sensors are disposed at equal angular intervals about the peripheral edge of the substrate seat.

11. The substrate support assembly of claim 7, wherein:

each of the at least one inner capacitive sensor and the plurality of outer capacitive sensors is disposed between a surface of the substrate seat and a top surface of the heater.

12. The substrate support assembly of claim 7, wherein:

the chucking mechanism comprises a bipolar electrostatic chuck, a monopolar electrostatic chuck, or a vacuum chuck.

13. A method of determining whether a wafer is fully chucked, comprising:

supplying a voltage to a plurality of capacitive sensors embedded within a chuck body, wherein:

the chuck body defines a substrate support surface that defines a substrate seat;

at least one of the plurality of capacitive sensors is positioned proximate a center of the substrate seat; and

at least one of the plurality of capacitive sensors is positioned proximate a peripheral edge of the substrate seat, wherein each of plurality of capacitive sensors comprises a negative electrode and a positive electrode with the negative electrode positioned adjacent to the positive electrode within the chuck body;

measuring a capacitance between the positive electrode and the negative electrode at each of the plurality of capacitive sensors; and

determining whether a wafer positioned atop the substrate seat is disposed flat against the substrate seat based at least in part on the capacitance of each of the plurality of capacitive sensors.

14. The method of determining whether a wafer is fully chucked of claim 13, wherein:

determining whether the wafer positioned atop the substrate seat is disposed flat against the substrate seat comprises comparing each capacitance to a baseline value.

15. The method of determining whether a wafer is fully chucked of claim 14, wherein:

determining whether the wafer positioned atop the substrate seat is disposed flat against the substrate seat comprises comparing the capacitance of each of the plurality of capacitive sensors to the capacitance of at least one other of the plurality of capacitive sensors.

16. The method of determining whether a wafer is fully chucked of claim 13, wherein determining whether the wafer positioned atop the substrate seat is disposed flat against the substrate seat comprises:

determining an average capacitance of the plurality of capacitive sensors; and

comparing the capacitance of each of the plurality of capacitive sensors to the average capacitance.

17. The method of determining whether a wafer is fully chucked of claim 13, further comprising:

determining one or both of a type of bowing of the wafer and a magnitude of bowing of the wafer based on the capacitance of each of the plurality of capacitive sensors.

18. The method of determining whether a wafer is fully chucked of claim 13, further comprising:

adjusting a chucking force based on the capacitance of each of the plurality of capacitive sensors.

19. The method of determining whether a wafer is fully chucked of claim 18, wherein:

adjusting the chucking force comprises increasing a chucking voltage to reduce a gap between the wafer and the substrate seat.

20. The method of determining whether a wafer is fully chucked of claim 13, wherein:

the voltage to the plurality of capacitive sensors is supplied after a chucking voltage is removed; and

determining whether a wafer positioned atop the substrate seat is disposed flat against the substrate seat comprises determining whether any residual static forces remain on the wafer before removing the wafer from the substrate support surface.