

WHAT IS CLAIMED IS:

1. A wireless substrate-like sensor for teaching transfer coordinates to a robotic substrate handling system, the sensor comprising:
 - a base portion sized and shaped like a substrate handled by the robotic substrate handling system;
 - an electronics housing coupled to the base portion;
 - a power module disposed within the electronics housing and configured to power components of the sensor;
 - at least one edge camera disposed near an edge of the base portion, the at least one edge camera having a field of view that images an alignment feature of the object within the field of view of the at least one edge camera of the wireless substrate-like sensor; and
 - a controller disposed within the electronics housing coupled to the at least one edge camera, the controller being configured to obtain an image from the at least one edge camera and determine a location of the object based on at least one image of the alignment feature, wherein the controller is configured to provide the determined location.
2. The wireless substrate-like sensor of claim 1, wherein the determined location is provided to the robotic substrate handling system.
3. The wireless substrate-like sensor of claim 1, wherein the determined location is provided to a user.
4. The wireless substrate-like sensor of claim 1, and further comprising an additional camera disposed in a central region of the base portion and configured to image a central portion of an object located underneath the wireless substrate-like sensor;
5. The wireless substrate-like sensor of claim 1, wherein the alignment feature is a round edge of a process chuck.
6. The wireless substrate-like sensor of claim 1, wherein the object is a process chuck.
7. The wireless substrate-like sensor of claim 1, wherein the alignment feature includes alignment markings on the object.

8. The wireless substrate-like sensor of claim 1, and further comprising a range device mounted relative to the base portion and operably coupled to the controller to provide an indication of range between the wireless substrate-like sensor and the object.
9. The wireless substrate-like sensor of claim 8, and further comprising a tilt/tip sensor operably coupled to the controller to measure tip and tilt of the wireless substrate-like sensor.
10. The wireless substrate-like sensor of claim 9, wherein the controller is configured to utilize the indication of range to correctly report XY coordinates from camera images.
11. The wireless substrate-like sensor of claim 1, wherein the at least one edge camera includes four edge cameras, each disposed proximate an edge of the base portion.
12. The wireless substrate-like sensor of claim 1, and further comprising one or more range sensors to determine Z at one or more points.
13. The wireless substrate-like sensor of claim 1, and further comprising a structured illuminator mounted relative to the base portion proximate at least one edge camera, the structured illuminator being configured to generate structured illumination in a field of view of the at least one edge camera.
14. The wireless substrate-like sensor of claim 13, wherein the wireless substrate-like sensor comprises at least four edge cameras and a structured illuminator disposed proximate each respective edge camera.
15. The wireless substrate-like sensor of claim 13, wherein the structured illumination is in the form selected from the group consisting of a dot, a circle, a plus symbol, a plurality of parallel lines, a sinusoidally varying intensity pattern in at least one of X and Y direction, diamonds shapes, and a checkerboard.
16. The wireless substrate-like sensor of claim 13, wherein the structured illumination is configured to allow a calibration operation in order to calibrate apparent range based on the structured illumination.
17. The wireless substrate-like sensor of claim 16, wherein the controller is configured to perform the calibration operation for each pair of edge camera and structured illuminator.
18. The wireless substrate-like sensor of claim 16, wherein the controller is configured to utilize stored calibration information in order to accurately calculate apparent range based on the appearance of the structured illumination in the camera images.

19. The wireless substrate-like sensor of claim 16, wherein the controller is configured to utilize measured apparent range to correctly report XY coordinates from camera images.
20. The wireless substrate-like sensor of claim 1, wherein the controller is configured to employ a camera proximate to the center of the sensor base to attempt to image a central aperture of the object and selectively engage the at least one edge camera if the attempt to image the central aperture of the object fails.
21. The wireless substrate-like sensor of claim 1, wherein the at least one edge camera is a monochrome camera.
22. The wireless substrate-like sensor of claim 1, wherein at least one edge camera is a color camera.
23. The wireless substrate-like sensor of claim 1, wherein the sensor has a form that is substantially similar to a semiconductor wafer.
24. The wireless substrate-like sensor of claim 1, wherein the sensor has a form that is substantially similar to a semiconductor process reticle.
25. A method of measuring the position of a process chuck of a semiconductor processing tool relative to a sensor held by a robotic manipulator of the semiconductor processing tool, the method comprising:
 - providing a sensor having at least one edge detecting camera;
 - causing the at least one edge detecting camera to obtain at least one image of a round outer surface of the process chuck;
 - calculating a position of a center of the process chuck based on analyzing the at least one image of the round outer surface of the process chuck; and
 - communicating the calculated position of the center of the process chuck to a controller of the robotic manipulator.
26. The method of claim 25, and further comprising providing a structured illuminator for each of the at least one edge camera and using the structured illumination to calibrate each camera/illuminator pair for range.
27. The method of claim 26, and further comprising using the calibrated sensor to obtain at least one subsequent image of the round outer surface of the process chuck.
28. The method of claim 25, and further comprising using stored calibration information to calculate lateral (XY) and range (Z) distances.

29. The method of claim 25, wherein communicating the calculated position includes transmitting wireless data indicative of the calculated position to the controller of the robotic manipulator.

30. The method of claim 25, wherein the at least one edge detecting camera includes four edge detecting cameras, and wherein calculating the position of the chuck includes analyzing at least one image from each edge detecting camera.

31. A method of measuring the position of an object within a semiconductor processing tool relative to a sensor held by a robotic manipulator of the semiconductor processing tool, the method comprising:

providing a sensor having at least one edge detecting camera;

causing the at least one edge detecting camera to obtain at least one image of an alignment mark of the object located within a field of view of the at least one camera;

calculating a position of an alignment mark of the object based on the at least one image of the alignment mark; and

communicating the calculated position to a controller of the robotic manipulator.

32. The method of claim 31, and further comprising providing a structured illuminator for each of the at least one edge camera and using structured illumination to calibrate each camera/illuminator pair for range.

33. The method of claim 32, and further comprising using the calibrated sensor to obtain at least one subsequent image of a chuck edge.

34. The method of claim 31, and further comprising using stored calibration information to calculate lateral (XY) and range (Z) distances.

35. The method of claim 31, wherein communicating the calculated position includes transmitting wireless data indicative of the calculated position to the controller of the robotic manipulator.

36. The method of claim 31, wherein the at least one edge detecting camera includes four edge detecting cameras, and wherein calculating the position of the chuck includes analyzing at least one image from each edge detecting camera.