

CLAIMS

1. A pre-alignment apparatus for a wafer, comprising:

a wafer stage for supporting the wafer, wherein a first alignment mark and a second alignment mark are provided on the wafer such that the first and second alignment marks are substantially symmetrical to each other with respect to a center of the wafer;

a peripheral vision acquisition system, configured to perform a first positional compensation for the wafer based on a relative positional relationship of an edge or a notch of the wafer with respect to the wafer stage; and

a mark detection system, configured to capture images of the first and second alignment marks and perform a second positional compensation for the wafer by determining a relative positional relationship of the center of the wafer with respect to a center of the wafer stage based on positions of the first and second alignment marks in a coordinate system of the mark detection system, wherein the mark detection system allows a higher centering and orientation accuracy of a pre-alignment process;

wherein each of the first and second positional compensations comprises a compensation for both a positional deviation and an angular deviation, and wherein the coordinate system of the mark detection system has a horizontal axis defined by a line passing through the center of the wafer stage and a center of the mark detection system and a vertical axis defined by a line crossing the horizontal axis at right angles and passing through the center of the wafer stage.

2. The pre-alignment apparatus for a wafer as recited in claim 1, wherein the mark detection system is configured to calculate a rotation angle and a deviation between a coordinate system of the alignment marks and the coordinate system of the mark detection system based on coordinates of the first and second alignment marks in the coordinate system of the mark detection system, and to further determine a relative positional relationship between the center of the wafer and the center of the wafer stage based on the rotation angle, the deviation and a relative positional relationship between

an origin of the coordinate system of the alignment marks and the center of the wafer, and wherein the coordinate system of the alignment marks has a horizontal axis defined by a line segment connecting the first and second alignment marks, the origin defined as a midpoint of the line segment connecting the first and second alignment marks and a vertical axis defined by a line passing through the origin and crossing the line segment at right angles.

3. The pre-alignment apparatus for a wafer as recited in claim 1, wherein the peripheral vision acquisition system comprises a linear array CCD detector, and wherein the mark detection system comprises a planar array CCD detector.

4. The pre-alignment apparatus for a wafer as recited in claim 1, wherein the mark detection system comprises a motion assembly, a focus adjustment assembly and a vision assembly for mark acquisition, the motion assembly configured to drive the vision assembly for mark acquisition to search for the first or second alignment mark, the focus adjustment assembly configured to adjust a focal length of the vision assembly for mark acquisition with respect to the first or second alignment mark, the vision assembly for mark acquisition configured to capture an image of the first or second alignment mark.

5. The pre-alignment apparatus for a wafer as recited in claim 4, wherein the focus adjustment assembly is connected to the motion assembly, and the vision assembly for mark acquisition is connected to the focus adjustment assembly, the motion assembly configured to drive the focus adjustment assembly to move along a radial direction of the wafer, the focus adjustment assembly configured to drive the vision assembly for mark acquisition to move along a vertical direction.

6. The pre-alignment apparatus for a wafer as recited in claim 4, wherein the vision assembly for mark acquisition comprises a point light source, a lens and a planar array CCD camera.

7. The pre-alignment apparatus for a wafer as recited in claim 1, wherein the peripheral vision acquisition system and the mark detection system are located on

opposite sides of the wafer along a radial direction of the wafer.

8. A pre-alignment method for a wafer, comprising:

step 1, providing, on the wafer, a first alignment mark and a second alignment mark that are substantially symmetrical to each other with respect to a center of the wafer;

step 2, performing a first positional compensation for the wafer by a peripheral vision acquisition system based on a relative positional relationship of an edge or a notch of the wafer with respect to a wafer stage;

step 3, searching for the first and second alignment marks on the wafer and capturing images thereof by a mark detection system;

step 4, determining a relative positional relationship between the center of the wafer and a center of the wafer stage based on positions of the first and second alignment marks in a coordinate system of the mark detection system; and

step 5, performing a second positional compensation for the wafer based on the determined relative positional relationship between the center of the wafer and the center of the wafer stage, wherein the mark detection system allows a higher centering and orientation accuracy of a pre-alignment process;

wherein each of the first and second positional compensations comprises a compensation for both a positional deviation and an angular deviation, and wherein the coordinate system of the mark detection system has a horizontal axis defined by a line passing through the center of the wafer stage and a center of the mark detection system and a vertical axis defined by a line crossing the horizontal axis at right angles and passing through the center of the wafer stage.

9. The pre-alignment method for a wafer as recited in claim 8, wherein step 4) comprises calculating a rotation angle and a deviation between a coordinate system of the alignment marks and the coordinate system of the mark detection system based on coordinates of the first and second alignment marks in the coordinate system of the mark

detection system, and further determining a relative positional relationship between the center of the wafer and the center of the wafer stage based on the rotation angle, the deviation and a relative positional relationship between an origin of the coordinate system of the alignment marks and the center of the wafer, and wherein the coordinate system of the alignment marks has a horizontal axis defined by a line segment connecting the first and second alignment marks, the origin defined as a midpoint of the line segment connecting the first and second alignment marks and a vertical axis defined by a line passing through the origin and crossing the line segment at right angles.