Claims:

1. A system for handling wafers mounted on film frames, comprising:

a wafer table providing a wafer table surface configured for securely retaining film frames thereon;

a wafer inspection system having a first image capture device configured for performing an inspection procedure upon a wafer mounted on a film frame and retained by the wafer table surface;

a second image capture device configured for capturing at least one image of portions of the wafer mounted on the film frame;

a processing unit configured to analyze the at least one image of portions of the wafer mounted on the film frame to determine a rotational misalignment angle and a rotational misalignment direction of the wafer relative to the film frame or a field of view of the first image capture device or the second image capture device by executing program instructions that perform image processing operations upon the at least one image; ~~and~~

a film frame handling apparatus configured for transporting the film frame on which the wafer is mounted to the wafer table surface,

wherein the film frame handling apparatus is ~~and~~ further configured for rotating the film frame to correct for any rotational misalignment of the wafer relative to the film frame, the first image capture device, and/or the second image capture device; and

wherein the rotational misalignment of the wafer is corrected during transportation of the film frame to the wafer table surface by the film frame handling apparatus prior to placement of film frame on the wafer table surface.

2. The system of claim 1, wherein the film frame handling apparatus is configured to rotate the film frame across an angular magnitude corresponding to the rotational misalignment angle in a direction opposite to the misalignment direction, wherein the wafer inspection system is configured for initiating the inspection procedure without the need for a film frame registration procedure involving establishing mating engagement of film frame alignment features with a set of registration elements, and wherein correction of the rotational misalignment of the wafer occurs without decreasing film frame handling throughput or inspection process throughput.

3. The system of claim 1, wherein the first image capture device is separate from the second image capture device.

4. The system of claim 3, wherein the second image capture device is configured to capture the at least one image of portions of the wafer on the film frame prior to placement of the film frame on the wafer table surface.

5. The system of claim 4, wherein the second image capture device is configured to capture the at least one image of portions of the wafer on the film frame while the film frame is in motion.

6. The system of claim 1, wherein the first image capture device and the second image capture device form portions of the wafer inspection system.

7. The system of claim 5, wherein the image processing operations are configured to identify at least one of:

one or more wafer structural and/or visual features including at least one of a wafer flat and a set of wafer gridlines, and

one or more film frame structural and/or visual features including a film frame flat.

8. The system of claim 1, wherein ~~correction for the rotational misalignment of the wafer occurs during transport and prior to placement of the film frame on the wafer table surface by the film frame handling apparatus~~ time required for transporting the film frame to the wafer table surface by the film frame handling apparatus corresponds to time taken when the misalignment angle is zero and regardless of time taken for correcting the rotational misalignment of the wafer.

9. The system of claim 1, wherein the film frame handling apparatus is configured to correct for the rotational misalignment of the wafer relative to the film frame only when a rotational misalignment of the wafer exceeds a programmable or a predetermined misalignment angle threshold.

10. The system of claim 1, wherein the film frame handling apparatus comprises:

a main body;

a plurality of vacuum elements coupled to the main body and configured for engaging portions of a border of the film frame by way of negative pressures, the plurality of vacuum elements controllably displaceable to multiple distinct positions transverse to and toward and away from a common axis corresponding to a center of the film frame; and

a capture positioning assembly for positioning the plurality of vacuum elements at each distinct position to facilitate engagement of the plurality of vacuum elements with the film frame border;

a rotational misalignment compensation motor configured for selectively and concurrently rotating the plurality of vacuum elements in a common direction about the common axis to facilitate precise correction for a rotational misalignment of the wafer relative to the film frame,

wherein each distinct position corresponds to a different film frame size.

11. The system of claim 10, wherein the film frame handling apparatus further comprises a plurality of displaceable capture arms carrying the plurality of vacuum elements and coupled to the main body.

12. The system of claim 11, further comprising a vertical displacement driver configured for controllably displacing the plurality of capture arms along a vertical direction normal to the wafer table surface.

13. The system of claim 12, wherein the film frame handling apparatus is configured to place the film frame directly on the wafer table surface.

14. A method for handling wafers mounted on film frames, comprising:

capturing at least one image of a wafer mounted on a film frame using an image capture device, prior to initiation of an inspection procedure on the wafer by a wafer inspection system;

analyzing the at least one image by way of image processing operations to determine a rotational misalignment angle and a rotational misalignment direction of the wafer

relative to the film frame and/or a set of reference axes of a field of view of the image capture device;

correcting for the rotational misalignment of the wafer relative to the film frame and/or the set of reference axes of the field of view of the image capture device by way of a film frame handling apparatus separate from the inspection system;

transporting the film frame to a wafer table surface of a wafer table corresponding to the inspection system,

wherein the rotational misalignment of the wafer is corrected during transportation of the film frame to the wafer table surface by the film frame handling apparatus and prior to placement of the film frame on the wafer table surface.

15. The method of claim 14, wherein correcting for the rotational misalignment of the wafer comprises rotating the film frame across an angular magnitude corresponding to the rotational misalignment angle in a direction opposite to the misalignment direction, wherein a film frame registration procedure in which a set of film frame structural features are aligned relative to a corresponding set of registration elements configured for mating engagement with the set of film frame structural features is avoided prior to initiating the inspection process, and wherein correcting for the rotational misalignment of the wafer occurs without decreasing film frame handling throughput or inspection process throughput.

16. The method of claim 14, ~~further comprising transporting the film frame to a wafer table surface of a wafer table corresponding to the inspection system, wherein correcting for the rotational misalignment of the wafer occurs prior to placement of the film frame on the wafer table surface~~ time required for transporting the film frame to the wafer table surface by the film frame handling apparatus corresponds to time taken when the misalignment angle is zero and regardless of time taken for correcting the rotational misalignment of the wafer.

17. The method of claim14, wherein capturing the at least one image occurs while the film frame is in motion during transport of the film frame to the wafer table surface.

~~18. The method of claim 14, wherein capturing the at least one image occurs after the film frame has been transported to the wafer table surface.~~

~~19~~18. The method of claim ~~18~~17, wherein the inspection system is an optical inspection system, and capturing the at least one image occurs by way of an image capture device of the optical inspection system.

~~20~~19. The method of claim 14, wherein determining the rotational misalignment angle and the rotational misalignment direction comprise performing image processing operations on the at least one captured images to detect an orientation of one or more wafer structural and/or visual features relative to (i) one or more film frame structural and/or visual features or spatial directions associated with such film frame structural and/or visual features, or (ii) the set of reference axes of the field of view of the image capture device.

~~21~~20. The method of claim ~~20~~19, wherein the wafer structural and/or visual features include at least one of a wafer flat, a set of wafer gridlines, and a film frame flat.

~~22~~21. The method of claim 14, wherein compensation or correction for the rotational misalignment of the wafer relative to the film frame occurs only when a rotational misalignment of the wafer relative to the film frame exceeds a programmable or a predetermined misalignment angle threshold.

~~23~~22. The method of claim ~~16~~14, wherein transporting the film frame to the wafer table surface comprises placing the film frame directly on the wafer table surface.