Claims

1. An edge exposure apparatus, comprising: a base frame; an edge exposure unit mounted on the base frame and configured to perform an edge exposure process on a wafer; a pre-alignment unit for centering and orienting the wafer and cooperating with the edge exposure unit in the edge exposure process; a cassette unit for storing and detecting the wafer; a robotic arm for transferring the wafer; and a master control unit for controlling the above units,

wherein the edge exposure unit and the pre-alignment unit share a common worktable, wherein the edge exposure unit comprises a light source, a fiber optic cable, a light homogenizer and an exposure assembly which are disposed along a direction in which light propagates,

wherein the exposure assembly comprises:

a motion switching/adjusting mechanism, having freedoms of movement in horizontal X and Y directions;

an exposure lens mounted on the motion switching/adjusting mechanism, the exposure lens configured to perform the edge exposure process on the wafer;

an absolute light intensity detection mechanism mounted on the motion switching/adjusting mechanism, the absolute light intensity detection mechanism configured for verification and validation of a light intensity in an area being exposed;

an exposure dose measuring mechanism mounted on the motion switching/adjusting mechanism, the exposure dose measuring mechanism configured to monitor an illuminance during the edge exposure process; and

a diaphragm switching mechanism disposed in positional correspondence with the exposure lens, and

wherein the motion switching/adjusting mechanism is configured to switch the wafer between an exposure mode and a pre-alignment mode and to enable translational movement of the wafer.

2. The edge exposure apparatus of claim 1, wherein the motion

switching/adjusting mechanism comprises a motion module mount, a planar motion module mounted on the motion module mount as well as a towline assembly and a module adapter plate both coupled to the planar motion module, wherein the exposure lens is mounted on the module adapter plate, and the module adapter plate has freedoms of movement in the horizontal X and Y directions.

3. The edge exposure apparatus of claim 2, wherein the absolute light intensity detection mechanism comprises a cylinder adapter, a switching cylinder, a sensor mount and a light intensity sensor, the switching cylinder coupled to the motion module mount through the cylinder adapter, the light intensity sensor coupled to the switching cylinder through the sensor mount and aligned with a field of view of the exposure lens.

4. The edge exposure apparatus of claim 2, wherein the exposure dose measuring mechanism comprises an adjusting/mounting plate, a pinhole, a filter and an illuminance sensor, the illuminance sensor fastened to the module adapter plate through the adjusting/mounting plate, the pinhole and the filter disposed between the adjusting/mounting plate and the illuminance sensor.

5. The edge exposure apparatus of claim 2, wherein the diaphragm switching mechanism comprises a linear motion module in fixed connection with the module adapter plate, a guiding block disposed on the linear motion module and a masking diaphragm coupled to the guiding block, the masking diaphragm disposed on the exposure lens.

6. The edge exposure apparatus of claim 1, wherein the pre-alignment unit comprises a mechanical vision system, a rotary table and a centering/orienting member, the rotary table disposed on the centering/orienting member and configured to support the wafer, the mechanical vision system being in positional correspondence with the rotary table.

7. The edge exposure apparatus of claim 1, comprising two edge exposure units and two pre-alignment units.

8. An edge exposure method using the edge exposure apparatus of claim 1, comprising:

taking out a wafer from a cassette unit and placing the wafer onto a pre-alignment unit, by a robotic arm;

centering and orienting the wafer by the pre-alignment unit;

performing an edge exposure process on the centered and oriented wafer by an edge exposure apparatus; and

removing the exposed wafer.

9. The edge exposure method of claim 8, wherein centering and orienting the wafer by the pre-alignment unit comprises:

obtaining, by fitting, a centroid of the wafer by scanning and sampling a circumferential edge of the wafer;

locating and sampling a notch in the wafer and thereby obtaining, by fitting, a center of the notch;

moving the notch, by rotation, to a predetermined position, such that a line leading from the centroid of the wafer toward the center of the notch is parallel to a positive X direction, and determining an offset of the centroid of the wafer; and

compensating for the offset of the centroid of the wafer by adjusting the wafer.

10. The edge exposure method of claim 8, wherein in the step of performing the edge exposure process on the centered and oriented wafer by the edge exposure apparatus, an actual expose dose applied to a surface of the wafer is estimated by edge exposure residual light collection and cumulative calculation, and wherein the actual expose dose serves as a basis for determining whether the edge exposure process has encountered an abnormality, and if so, an alert is raised.