What is claimed is:

1. An optical system comprising:

a substrate stage configured to support a substrate during inspection;

an optics assembly including a sensor head positioned above the substrate stage, the sensor head including:

a movable mounting structure configured to be raised and lowered;

at least one optical component mounted to the movable mounting structure that is configured to direct a laser beam towards the substrate stage;

an electronically controlled actuator connected to the movable structure and configured to raise and lower the sensor head relative to the substrate stage; and

a mass support device connected to the movable structure configured to support at least a portion of the weight of the movable mounting structure.

2. The optical system of claim 1, wherein the mass support device includes an adjustable preloaded and a dynamically controlled adjustment mechanism configured to automatically maintain a target weight load on the mass support device during inspection.

3. The optical system of claim 1, wherein the at least one optical component mounted to the movable mounting structure includes a first mirror, a second mirror, a first lens, a second lens, and a camera.

4. The optical system of claim 1, wherein the mass support device is a gas cylinder.

5. The optical system of claim 1, wherein the mass support device is a gas cylinder and wherein the mass support system further comprises an adjustment mechanism that allows air to escape the gas cylinder and that provides additional gas to the gas cylinder to enable the gas cylinder to continuously support the weight of the movable mounting structure as the movable mounting structure is raised and lowered by the electronically controlled actuator.

6. The optical system of claim 1, wherein the mass support device includes an adjustable preloaded and a dynamic control mechanism, wherein the dynamic control mechanism is configured to automatically maintain the amount of weight load supported by the mass support device as the movable mounting structure raises and lowers during inspection.

7. The optical system of claim 1, further comprising a bracket assembly that includes an alignment adjustment plate that aligns the at least one optical component mounted to the movable mounting structure with a laser in the optics assembly, the alignment plate configured to be adjusted for rotation about both a vertical axis and a horizontal axis.

8. The optical system of claim 7, wherein the alignment plate is located in a first vertical plane and the movable mounting structure is located in a second vertical plane, wherein the first vertical plane and the second vertical plane are offset, and wherein the alignment plate and movable plate overlap in the horizontal direction and define a gap between the alignment plate and the movable mounting plate, wherein the electronically controlled actuator and mass support device are at least partially housed within the gap.

9. The optical system of claim 1, wherein the movable structure is configured to move vertically as well as horizontally during inspection.

10. A method of optical inspection, comprising:

securing a substrate onto an automated stage;

automatically moving the stage in an X-Y plane to pass the substrate under an optical sensor head;

automatically raising and lowering the optical sensor head to follow the terrain features on the substrate such that surface features on the substrate remain in focus;

wherein the step of automatically raising and lowering the optical sensor head includes dynamically controlling a mass support device that supports at least a portion of the weight of a vertically movable portion of the optical sensor head.

11. The method of claim 10, further comprising adjusting the preload of the mass support device based on the weight of the vertically movable portion of the optical sensor head.

12. The method of claim 10, further comprising aligning optical components on the vertical movable portion of the optical sensor head with optical components located in a non-vertically movable portion of the optical sensor head.

13. The method of claim 10, wherein the step of dynamically controlling a mass support device includes automatically allowing gas to escape from a gas cylinder and adding gas to the gas cylinder.

14. The method of claim 10, wherein the step of automatically raising and lowering the optical sensor head includes the use of a stepper motor.

15. A flying sensor head comprising:

focusing optics adapted to direct a sensor beam from an illumination source onto a substrate and to receive a modified sensor beam returned from the surface and direct it to a sensor that provides an output indicative of a characteristic of the substrate as a result of the incidence of the modified sensor beam thereon;

a support plate to which a mobile portion of the focusing optics are coupled, the support plate being movable relative to the substrate so as to position a focal plane defined by the focusing optics substantially at a surface of the substrate;

a mass support device coupled between the support plate and a mounting bracket to support substantially all of the mass of the support plate and the mobile portion of the focusing optics;

an actuator coupled between the support plate and a mounting bracket to position the mobile portion of the focusing optics relative to the substrate; and

a focus sensor for determining a position of the mobile portion of the optics relative to the substrate.

16. The flying sensor head of claim 15, wherein the sensor beam is selected from a group consisting of polarized light, coherent light, monochromatic light, and broadband illumination.

17. The flying sensor head of claim 15, wherein the illumination source is adapted to provide a pump sensor beam and a probe sensor beam, the probe sensor beam being incident upon the sensor, the pump sensor beam being directed to a photon beam dump.

18. The flying sensor head of claim 15, wherein the flying sensor head is coupled to an inspection system selected from a group consisting of an ellipsometer, a polarimeter, a scatterometer, an opto-acoustic metrology system, an optical imaging inspection system, an interferometer, and a confocal imaging system.

19. The flying sensor head of claim 15, wherein the mass support device includes an adjustable preload and a dynamically controlled adjustment mechanism that are configured to automatically maintain a weight load on the mass support device during inspection.

20. The flying sensor head of claim 15, wherein the mass support device is a gas cylinder and wherein the mass support system further comprises a mechanism that allows air to escape the gas cylinder and that also provides additional gas to the gas cylinder to enable the gas cylinder to continuously support at least a portion of the weight of the mobile portion of the optics as the mobile portion of the optics is raised and lowered by the actuator.

What is claimed is:

1. An optical system comprising:

a substrate stage configured to support a substrate during inspection;

an optics assembly including a sensor head positioned above the substrate stage, the sensor head including:

a movable mounting structure configured to be raised and lowered with respect to the substrate stage;

at least one optical component mounted to the movable mounting structure such that the optical component is configured to move with the movable mounting structure, wherein the optical component is configured to direct a laser beam towards the substrate stage;

an electronically controlled actuator connected to the movable mounting structure and configured to raise and lower the sensor head relative to the substrate stage; and

a mass support device connected to the movable mounting structure configured to support at least a portion of the weight of the movable mounting structure, wherein the mass support device is configured to adjust itself upon movement of the electronically controlled actuator.

2. The optical system of claim 1, wherein the mass support device includes an adjustable preloaded and a dynamically controlled adjustment mechanism configured to automatically maintain a target weight load on the mass support device during inspection.

3. The optical system of claim 1, wherein the at least one optical component mounted to the movable mounting structure includes a first mirror, a second mirror, a first lens, a second lens, and a camera.

4. The optical system of claim 1, wherein the mass support device is a gas cylinder.

5. The optical system of claim 1, wherein the mass support device comprises a gas cylinder and an adjustment mechanism that allows air to escape the gas cylinder and that provides

additional gas to the gas cylinder to enable the gas cylinder to continuously support the weight of the movable mounting structure as the movable mounting structure is raised and lowered by the electronically controlled actuator.

6. The optical system of claim 1, wherein the mass support device includes an adjustable preloaded and a dynamic control mechanism, wherein the dynamic control mechanism is configured to automatically maintain the weight supported by the mass support device as the movable mounting structure raises and lowers during inspection.

7. The optical system of claim 1, further comprising a bracket assembly that includes an alignment adjustment plate that aligns the at least one optical component mounted to the movable mounting structure with a laser in the optics assembly, the alignment plate configured to be adjusted for rotation about both a vertical axis and a horizontal axis.

8. The optical system of claim 7, wherein the alignment plate is located in a first vertical plane and the movable mounting structure is located in a second vertical plane, wherein the first vertical plane and the second vertical plane are offset, and wherein the alignment plate and movable mounting structure overlap in the horizontal direction and define a gap between the alignment plate and the movable mounting structure, wherein the electronically controlled actuator and mass support device are at least partially housed within the gap.

9. The optical system of claim 1, wherein the movable mounting structure is configured to move vertically as well as horizontally during inspection.

10. A method of optical inspection, comprising:

securing a substrate having terrain features onto an automated stage, wherein the terrain features have varying heights;

automatically moving the stage in an X-Y plane to pass the substrate under an optical sensor head, wherein the optical sensor head includes one or more sensor head optics;

automatically raising and lowering the optical sensor head with respect to the substrate to follow the terrain features on the substrate such that surface features on the substrate remain in focus;

wherein the step of automatically raising and lowering the optical sensor head includes dynamically controlling an electronically controlled actuator in cooperation with adjusting a mass support device to support at least a portion of the weight of a vertically movable portion of the optical sensor head at an adjusted height resulting from the raising and lowering operations.

11. The method of claim 10, further comprising adjusting the preload of the mass support device based on the weight of the vertically movable portion of the optical sensor head.

12. The method of claim 10, further comprising aligning optical components on the vertical movable portion of the optical sensor head with optical components located in a non-vertically movable portion of the optical sensor head.

13. The method of claim 10, wherein the step of dynamically controlling a mass support device includes automatically allowing gas to escape from a gas cylinder and adding gas to the gas cylinder.

14. The method of claim 10, wherein the step of automatically raising and lowering the optical sensor head includes use of a stepper motor.

15. A flying sensor head comprising:

focusing optics adapted to direct a sensor beam from an illumination source onto a substrate and to receive a modified sensor beam returned from the surface and direct it to a sensor that provides an output indicative of a characteristic of the substrate as a result of the incidence of the modified sensor beam thereon;

a support plate to which a mobile portion of the focusing optics are coupled, the support plate being vertically movable relative to the substrate so as to position a focal plane defined by the focusing optics substantially at a surface of the substrate;

a mass support device coupled between the support plate and a mounting bracket to support substantially all of the mass of the support plate and the mobile portion of the focusing optics;

an actuator coupled between the support plate and the mounting bracket to position the mobile portion of the focusing optics relative to the substrate, wherein the actuator is configured to operate in cooperation with the mass support device such that adjustment of the mass support device occurs during movement of the actuator; and

a focus sensor for determining a vertical position of the mobile portion of the optics relative to the substrate.

16. The flying sensor head of claim 15, wherein the sensor beam is selected from a group consisting of polarized light, coherent light, monochromatic light, and broadband illumination.

17. The flying sensor head of claim 15, wherein the illumination source is adapted to provide a pump sensor beam and a probe sensor beam, the probe sensor beam being incident upon the sensor, the pump sensor beam being directed to a photon beam dump.

18. The flying sensor head of claim 15, wherein the flying sensor head is coupled to an inspection system selected from a group consisting of an ellipsometer, a polarimeter, a scatterometer, an opto-acoustic metrology system, an optical imaging inspection system, an interferometer, and a confocal imaging system.

19. The flying sensor head of claim 15, wherein the mass support device includes an adjustable preload and a dynamically controlled adjustment mechanism that are configured to automatically maintain a weight load on the mass support device during inspection.

20. The flying sensor head of claim 15, wherein the mass support device comprises a gas cylinder and a mechanism that allows air to escape the gas cylinder and that also provides additional gas to the gas cylinder to enable the gas cylinder to continuously support at least a portion of the weight of the mobile portion of the optics as the mobile portion of the optics is raised and lowered by the actuator.