WHAT IS CLAIMED IS:

1. A position measurement system configured to determine a position of a first object relative to a second object, comprising:

an encoder head mounted on the first object,

a grating mounted on the second object,

wherein the grating comprises a first array of grating lines in a first direction and a second array of grating lines in a second direction to diffract a measurement beam incident on the first and second arrays in at least one first diffracted beam in the first direction and in at least one second diffracted beam in the second direction, wherein the at least one first diffracted beam is for position measurement in the first direction and wherein the at least one second diffracted beam is for position measurement in the second direction,

wherein the measurement beam has a power quantity, and wherein the grating is configured to distribute the power quantity unevenly over the at least one first diffracted beam and the at least one second diffracted beam.

2. The position measurement system of claim 1, wherein the first array comprises a first period and a first duty cycle, wherein the second array comprises a second period and a second duty cycle, wherein the first period and the second period are the same, and wherein the first duty cycle is different from the second duty cycle.

3. The position measurement system of one of the preceding claims, wherein the first direction is a main measurement direction, and the second direction is a sub measurement direction, and wherein the grating is configured to distribute the power quantity of the measurement beam such that the at least one first diffracted beam has substantially more power than the at least one second diffracted beam.

4. The position measurement system of one of the preceding claims, wherein the grating is configured to distribute the power quantity over substantially the complete grating unevenly over the at least one first diffracted beam and the at least one second diffracted beam.

5. The position measurement system of one of the preceding claims, wherein the first direction and the second direction are perpendicular with respect to each other.

6. The position measurement system of one of the preceding claims, wherein a portion of the second array in the second direction comprises a third duty cycle different from the second duty cycle, wherein the position measurement system is arranged to determine an absolute position of the encoder head relative to the portion.

7. The position measurement system of claim 6, wherein the portion has a third period, wherein the second period and the third period are the same.

8. The position measurement system of one of the preceding claims, wherein the at least one first diffracted beam and the at least one second diffracted beam are first order diffraction beams of the measurement beam.

9. A lithographic apparatus comprising:

a support structure constructed to support a patterning device comprising a pattern;

a projection system configured to project the pattern on a substrate;

a substrate stage constructed to hold the substrate; and

a position measurement system according to one of the preceding claims,

wherein the position measurement system is arranged to determine a position of one of the support structure and the substrate stage relative to the projection system.

10. The lithographic apparatus of claim 9, comprising a reference frame, wherein the grating is mounted on the substrate stage, and wherein the encoder head is mounted on the reference frame.

11. The lithographic apparatus of claim 10, wherein the substrate stage comprises a first surface and a second surface, wherein the first surface is on a top side of the substrate stage, wherein the second surface is at a bottom side of the substrate stage, wherein the first surface is arranged to hold the substrate, wherein the second surface is arranged to hold the grating.

12. A grating for a position measurement system, wherein the grating comprises a first array of grating lines in a first direction and a second array of grating lines in a second direction to diffract a measurement beam incident on the first and second arrays in at least one first diffracted beam in the first direction and in at least one second diffracted beam in the second direction, wherein the at least one first diffracted beam is used for position measurement in the first direction and wherein the at least one second diffracted beam is used for position measurement in the second direction, wherein the measurement beam has a power quantity, and wherein the grating is configured to distribute the power quantity unevenly over the at least one first diffracted beam and the at least one second diffracted beam.

13. The grating of claim 12, wherein the first array comprises a first period and a first duty cycle, wherein the second array comprises a second period and a second duty cycle, wherein the first period and the second period are the same, and wherein the first duty cycle is different from the second duty cycle.

14. The grating of claim 13, wherein a portion of the second array comprises a third duty cycle different from the second duty cycle.

15. The grating of claim 14, wherein the portion has a third period, wherein the second period and the third period are the same.

16. A method to determine a position of a first object relative to a second object, comprising:

providing an encoder head on the first object,

providing a grating on the second object, wherein the grating comprises a first array of grating lines in a first direction and a second array of grating lines in a second direction to diffract a measurement beam incident on the first and second arrays in at least one first diffracted beam in the first direction and in at least one second diffracted beam in the second direction, wherein the at least one first diffracted beam is used for position measurement in the first direction and wherein the at least one second diffracted beam is used for position measurement in the second direction,

projecting by the encoder head a measurement beam on the grating, wherein the measurement beam has a power quantity, and wherein the grating is configured to distribute the

power quantity unevenly over the at least one first diffracted beam and the at least one second diffracted beam,

receiving by the encoder head the at least one first diffracted beam and the at least one second diffracted beam, and

determining a position of the first object relative to the second object on the basis of the at least one first diffracted beam and/or the at least one second diffracted beam.

17. The method of claim 16, wherein the first direction is a main measurement direction, and the second direction is a sub measurement direction, and wherein the grating is configured to distribute the power quantity of the measurement beam such that the at least one first diffracted beam has substantially more power than the at least one second diffracted beam.

18. The method of claim 16 or 17, wherein the first array comprises a first period and a first duty cycle, wherein the second array comprises a second period and a second duty cycle, wherein the first period and the second period are the same, and wherein the first duty cycle is different from the second duty cycle.

19. The method of claim 16, 17 or 18, wherein the second array in the second direction diffracts at a measurement location a measurement beam incident on the second array in at least one further diffracted beam, wherein the at least one further diffracted beam is not used for position measurement in the first and/or second direction,

the method comprising the step of zeroing the position measurement system by determining the measurement location as a result of a decrease of power in the at least one second diffracted beam as a result of a part of the measurement beam being diffracted in the at least one further diffracted beam.

WHAT IS CLAIMED IS:

1. A position measurement system configured to determine a position of a first object relative to a second object, comprising:

an encoder head mounted on the first object,

a grating mounted on the second object,

wherein the grating comprises a first array of grating lines in a first direction and a second array of grating lines in a second direction to diffract a measurement beam incident on the first and second arrays in at least one first diffracted beam in the first direction and in at least one second diffracted beam in the second direction, wherein the at least one first diffracted beam is for position measurement in the first direction and wherein the at least one second diffracted beam is for position measurement in the second direction,

wherein the measurement beam has a power quantity, and wherein the grating is configured to distribute the power quantity unevenly over the at least one first diffracted beam and the at least one second diffracted beam.

2. The position measurement system of claim 1, wherein the first array comprises a first period and a first duty cycle, wherein the second array comprises a second period and a second duty cycle, wherein the first period and the second period are the same, and wherein the first duty cycle is different from the second duty cycle.

3. The position measurement system of one of the preceding claims, wherein the grating is configured to distribute the power quantity over substantially the complete grating unevenly over the at least one first diffracted beam and the at least one second diffracted beam.

4. The position measurement system of one of the preceding claims, wherein a portion of the second array in the second direction comprises a third duty cycle different from the second duty cycle, wherein the position measurement system is arranged to determine an absolute position of the encoder head relative to the portion.

5. A lithographic apparatus comprising:

a support structure constructed to support a patterning device comprising a pattern;

a projection system configured to project the pattern on a substrate;

a substrate stage constructed to hold the substrate; and

a position measurement system according to one of the preceding claims,

wherein the position measurement system is arranged to determine a position of one of the support structure and the substrate stage relative to the projection system.

6. The lithographic apparatus of claim 5, comprising a reference frame, wherein the grating is mounted on the substrate stage, and wherein the encoder head is mounted on the reference frame.

7. The lithographic apparatus of claim 5, wherein the substrate stage comprises a first surface and a second surface, wherein the first surface is on a top side of the substrate stage, wherein the second surface is at a bottom side of the substrate stage, wherein the first surface is arranged to hold the substrate, wherein the second surface is arranged to hold the grating.

8. A grating configured for use in the position measurement system of claims 1- 4.

9. A grating for a position measurement system, wherein the grating comprises a first array of grating lines in a first direction and a second array of grating lines in a second direction to diffract a measurement beam incident on the first and second arrays in at least one first diffracted beam in the first direction and in at least one second diffracted beam in the second direction, wherein the at least one first diffracted beam is used for position measurement in the first direction and wherein the at least one second diffracted beam is used for position measurement in the second direction,

wherein the measurement beam has a power quantity, and wherein the grating is configured to distribute the power quantity unevenly over the at least one first diffracted beam and the at least one second diffracted beam.

10. The grating of claim 9, wherein the first array comprises a first period and a first duty cycle, wherein the second array comprises a second period and a second duty cycle, wherein the

first period and the second period are the same, and wherein the first duty cycle is different from the second duty cycle.

11. The grating of claim 10, wherein a portion of the second array comprises a third duty cycle different from the second duty cycle.

12. A grating comprising;
a first array of grating lines in a first direction;
a second array of grating lines in a second direction;
wherein the first array of grating lines comprises a first duty cycle,
wherein the second array of grating lines comprises a second duty cycle,
wherein the first duty cycle and the second duty cycle are different.

13. The grating of claim 12, wherein the difference between the first duty cycle and the second duty cycle is substantially the same over the whole grating.

14. The grating of claim 12 or 13, wherein a portion of the second array comprises a third duty cycle different from the second duty cycle.

15. The grating of claims 12-14, wherein the first array has a first period, wherein the second array has a second period, wherein the first period and the second period are the same.