CLAIMS

1. A reactor for depositing one or more atomic layers of at least one material onto a substrate, wherein the reactor, when assembled, comprises:

- a reaction chamber, the reaction chamber accommodating

- a showerhead comprising at least one gas outlet that is configured for providing a gas stream of at least one precursor or of at least one reaction gas or of at least one component of the at least one material,

- a base stage that is rotatable around a base stage rotation axis, and

- at least one substrate holder that is arranged on the base stage and configured for rotating the substrate around a substrate rotation axis in such a way that the base stage rotation axis and the substrate rotation axis are inclined with respect to each other.

2. The reactor according to claim 1, wherein the at least one substrate holder comprises a substrate holder driving mechanism that includes a motor and connected thereto a substrate mounting support for holding the substrate and rotating the substrate around the substrate rotation axis.

3. The reactor according to claim 1 or 2, comprising a plurality of substrate holders arranged on the base stage, wherein each of the plurality of substrate holders is independently rotatable relative to the base stage about a respective substrate rotation axis.

4. The reactor according to at least one of the preceding claims, wherein the at least one substrate holder can be releasably mounted onto the base stage.

5. The reactor according to at least one of the preceding claims, wherein the substrate holder is arranged and configured to rotate the substrate with the substrate rotation axis being substantially perpendicular to the base stage rotation axis.

6. The reactor according to at least one of the preceding claims, comprising a base stage heating element with which the base stage can be heated, or a radiation

source for providing infrared radiation, wherein the radiation source is configured and arranged to provide infrared radiation heating spots so that a substrate held by the substrate holder can be heated in spatially localized areas.

7. The reactor according to at least one of the preceding claims, comprising a substrate holder heating element arranged and adapted to heat the at least one substrate holder.

8. The reactor according to at least one of the preceding claims, wherein the showerhead is divided spatially into four area sections, and wherein in a first section there is a first gas outlet for providing a first gas stream comprising a first precursor or reaction gas to be deposited and/or at least one component of the to be deposited material, in a second section there is a second gas outlet for introducing a first purge gas, in a third section there is a third gas outlet for providing a second gas stream comprising a second precursor or reaction gas to be deposited and/or at least one component of the to be deposited material, and in a fourth section there is a fourth gas outlet for introducing a second purge gas.

9. A method of depositing one or more atomic layers of at least one material onto a substrate by means of a reactor according to at least one of the preceding claims, the method comprising the steps of:

- arranging the substrate on the at least one substrate holder,

- arranging the substrate holder with the substrate on the base stage in the reaction chamber,

- introducing the gas stream comprising the at least one precursor, reaction gas and/or at least one component of the at least one material through the at least one gas outlet into the reaction chamber,

- rotating the substrate about the base stage rotation axis with the base stage and additionally rotating the substrate about the substrate rotation axis with the substrate holder, the base stage rotation axis and the substrate rotation axis being inclined to each other, and

- depositing one or more atomic layers of the at least one material and/or the at least one component of the at least one material on the substrate.

10. The method according to claim 9, wherein alternating layers of a first material and a second material with controlled thicknesses are deposited onto the substrate in the form of concentric rings, the first material and the second material differing in at least one physical property.

11. The method according to claim 9 or 10, wherein the at least one material is deposited at a deposition rate of 1 nm per minute or more, preferably, of 10 nm per minute or more.

12. The method according to at least one of claims 9 to 11, comprising cleaning the substrate prior or after to arranging the substrate holder with the substrate on the base stage in the reaction chamber or a pre-chamber by means of a CO_2 snow gun, ozone source and/or generator, a plasma source, by means of sputtering or etching.

13. A use of the reactor of at least one of claims 1 to 8 for producing a Fresnel zone plate, the Fresnel zone plate comprising a first material and a second material arranged alternately in a sequence of concentric rings following Fresnel's zone plate law, the Fresnel zone plate having an aspect ratio of an outermost zone of 50 or more and an outermost zone with a zone width of 50 nm or less and/or the Fresnel zone plate having a layer width accuracy Δw(RMS)/w of 0.01 or less, an roundness of the respective zones of $R \geq 1 - \frac{1/2 \cdot w_N}{b}$ or more, where w_N denotes the width of the outermost zone, and/or having an aspect ratio of the outermost zone of 50 or more.

14. An X-ray microscope for producing a magnified image of an object using X-rays, the X-ray microscope comprising

- an X-ray detector for detecting X-rays provided by an X-ray source and penetrating the object,

- a first X-ray optic that can be automatically moved into and out of an X-ray beam path between the X-ray source and the object, and

- a second X-ray optic that is a Fresnel zone plate comprising a first material and a second material arranged alternately in a sequence of concentric rings following Fresnel's zone plate law, the Fresnel zone plate having an aspect ratio of an outermost zone of 50 or more and an outermost zone with a zone width of 50 nm or less and/or the Fresnel zone plate having a layer width accuracy Δw(RMS)/w of 0.01 or less, an roundness of the respective zones of $R \geq 1 - \frac{1/2 \cdot w_N}{b}$ or more, where w_N denotes the width of the outermost zone, and/or having an aspect ratio of the outermost zone of 50 or more, and that can be automatically moved into and out of an X-ray beam path between the object and the X-ray detector, and

- a control unit that is configured for

  - controlling the automatic movements of the first X-ray optic and the second X-ray optic into and out of the beam path, and

  - aligning the first X-ray optic and the second X-ray optic with respect to the beam path, wherein

  for producing in micro a X-ray imaging mode an image of the object with micrometre resolution, the first X-ray optic and the second X-ray optic can be moved out of the beam path and for producing in a nano X-ray imaging mode an image of the object with nanometre resolution, the first X-ray optic and the second X-ray optic can be moved into the beam path.

15. The X-ray microscope according to claim 14, comprising a positioning system that is arranged and configured for guiding a transition from the micro a X-ray imaging mode to the nano X-ray imaging mode and vice versa.