carrying body has an extremum at this nominal temperature. The extremum can be a maximum or a minimum.

[0019] According to the invention, the above-described particle-optical apparatus and the method for operating the same are preferably employed in a lithography system or/and a microscopy system.

[0020] Embodiments of the invention are described hereinbelow with reference to drawings, wherein:

## BRIEF DESCRIPTION OF THE DRAWINGS

[0021] **FIG. 1** shows an electron microscopy system according to an embodiment of the invention,

[0022] **FIG. 2** is a perspective partial view of a beam deflector according to an embodiment of the invention which may be used in the microscopy system of **FIG. 1**,

[0023] **FIG. 3** is a plan view on the beam deflector shown in **FIG. 3**,

[0024] **FIG. 4** shows a graph showing the temperature dependence of a ferrite material which may be used in the beam deflector according to **FIGS. 2 and 3**, and

[0025] **FIG. 5** shows a lithography system according to an embodiment of the invention in which the beam deflectors according to **FIGS. 2 and 3** may be used.

## DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0026] **FIG. 1** schematically shows a microscopy system **1** for imaging a semiconductor wafer **5** positioned in an object plane **3** of the microscopy system **1** onto a position-sensitive detector **7**. To this end, the microscopy system **1** comprises a microscopy optics **11** which provides a beam path for secondary electrons to electron-optically image a region **13** of the object plane **3** onto the detector **7**. The beam path used for imaging the region **13** which is imaged onto the detector **7** is displaceable parallel to an optical axis **17** of the microscopy system **1** (in **FIG. 1 a** displacement is designated by M).

[0027] The microscopy optics **11** comprises a plurality of components which are symmetrically disposed centrally in respect of the optical axis **17**, namely an objective lens **19**, a field lens **21** and a further magnification optics **23**. Between the objective lens **19** and the field lens **21**, there are provided two beam deflectors **25** and **27** spaced apart from each other along the optical axis **17**. The deflectors **25, 27** are controlled by a controller **29**. Each one of the beam deflectors **25, 27** provides for the secondary electron beam **14** an adjustable deflection angle β controllable by the controller **29**, the deflection angles provided by the two beam deflectors **25, 27** being, however, opposite in sign. Accordingly, the secondary electron beam **14** passes through the two lenses **19, 21** straightly, however, adjustably displaced parallel to the optical axis **17**.

[0028] The secondary electrons extracted from the semiconductor wafer **5** are accelerated by an extraction electrode **18** in a direction parallel to the optical axis **17**.

[0029] The objective lens **19** provides a focusing field for the secondary electron beam **14**, the optical axis **31** of which is displaceable relative to the optical axis **17** of the other components. The controller **29** controls the objective lens **19** such that the optical axis **31** of the objective lens **19** vertically intersects centrally the region **13** of the object plane **3** which is imaged on the detector **7**. An example of such an objective lens is described in the article "MOL-"("moving objective lens"), Optik 48 (1977), no. 2, pages 255-270, by E. Goto et al., or in U.S. Pat. No. 4,376,249. A further example of such an objective lens is described in U.S. Ser. No. 2003/0066961 A1 of the assignee of the present application.

[0030] The secondary electrons are extracted from the semiconductor wafer **5** by a primary electron beam **33** which is generated by an electron source **35**, which is collimated by a collimating lens **37** and shaped by an aperture stop **39** and supplied to a beam combiner/beam splitter **41**. The beam combiner **41** superimposes the primary electron beam **33** on the beam path of the secondary electron beam **14**. The primary electron beam **33** passes through the field lens **21**, the deflectors **25, 27** and the objective lens **19**. The primary electron beam **33** is also deflected by the deflectors **25, 27**, however, not necessarily exactly by the same angle as the secondary electron beam **14**. However, it is sufficient for the primary beam **33** to illuminate the field **13** imaged onto the detector **7** merely fairly homogenously. Accordingly, the demands put on the imaging properties of the optical system **11** are less for the primary electron beam **33** than for the secondary electron beam **14**.

[0031] **FIG. 2** schematically shows the deflector **25** in perspective partial view. It comprises a plurality of rings **43** disposed concentrically in respect of the optical axis **17** and made of a material with a low permeability number, and a plurality of rings **45** which are made of a material with a high permeability number and are disposed between adjacent rings **43** made of the material with the low permeability number. The rings **43, 45** are thus alternately disposed on each other as a stack. Current conductors **47** engage around the rings **43, 45**, which current conductors extend substantially parallel to the optical axis **17** and radially penetrate the uppermost and lowermost rings **43**.

[0032] **FIG. 3** shows the arrangement of the current conductor windings in circumferential direction around the optical axis **17**. The angles $\Theta_1$, to $\Theta_7$ indicated in **FIG. 3** have the following values: $\Theta_1$=21.6°, $\Theta_2$=41.6°, $\Theta_3$=47.6°, $\Theta_4$=62.4°, $\Theta_5$=68.4°, $\Theta_6$=78.5° and $\Theta_7$=**84.5°. These angles are selected such that the magnetic field generated by the current conductor windings 47 is a substantially homogeneous magnetic field oriented in y-direction.**

[0033] By exciting the current conductor windings **47** with a current adjusted by the controller **29**, it is thus possible to deflect the secondary electron beam in x-direction by adjustable angles β.

[0034] The rings **43** with the low permeability number can be made of a material called Macor® which is obtainable from Corning, Inc., New York, USA.

[0035] The rings **45** made of the material with the high permeability number are made of a manganese/zinc/ferrite material which is obtainable from Ceramic Magnetics, Inc., New Jersey, USA under the product name MN-60 for example.

[0036] The permeability number of this material is dependent upon the temperature. **FIG. 4** shows a graph of this dependency for a sample of this material. It is evident