the optically located measurement window. It has proven to be advantageous if a lens is moved to the feature on the substrate. The necessary focusing can be accomplished with an autofocus system. In the case of the measurement method performed here, the edges of the features on the substrate are determined. Because the edges to be measured are approached optically, the measurement window for the AFM can be defined very tightly around the edges to be measured. The measurement table or also the support plate is then displaced correspondingly so that the feature to be measured ends up in the measurement window under the AFM. During the AFM measurement a determination is made, for example, of the deviation of the measurement table from the reference position using an interferometer.

[0015] An important feature for position measurement on large substrates is, as already mentioned above, the rigid coupling between the sensing system (lens, AFM) and the interferometer. For this aspect, a horizontal movement (in the X/Y plane) of the AFM sensing tip would be rather negative. The accuracy of the measurement could additionally be increased if the tip of the AFM were as immovable as possible. In this case the substrate together with the measurement table is displaced, and in the process is scanned over its entire surface by the AFM. A measurement method of this kind then has, however, a negative effect on the throughput rate.

[0016] A further nonoptical method could be implemented with an electron beam. To ensure, that the measurement does not need to be performed in a vacuum even when an electron beam is used, the electron beam lens used is one that implements in miniature, in its microscopic structure, a conventional electron-microscope column. Here again, an advantageous combination with a conventional lens is conceivable. The lens makes it possible to accelerate the process of moving to points on the substrate that are to be measured. This reduces the time of action of the electron beam on the substrate. This reduces the (already small) amount of charging in systems that operate exclusively with electron beam lenses, since a large portion of the measurement operation (e.g. focusing, fine adjustment of the measurement window, etc.) is optical. Measurement using an electron beam can considerably increase the resolution of a measurement system as compared to a conventionally optical measurement system.

BRIEF DESCRIPTION OF DRAWINGS

[0017] The drawings schematically depict four embodiments of the measuring instrument according to the present invention, which are described below with reference to the drawings.

[0018] **FIG. 1** shows a first embodiment of the measuring instrument in which the substrate is illuminated by transmitted light, the refined measurement being performed by way of an AFM;

[0019] **FIG. 2** shows a second embodiment of the measuring instrument in which the substrate is illuminated by incident light, the refined measurement being performed by way of an AFM;

[0020] **FIG. 3** shows a third embodiment of the measuring instrument in which the substrate is illuminated by transmitted light, the refined measurement being performed by way of an electron microscope; and

[0021] **FIG. 4** shows a fourth embodiment of the measuring instrument in which the substrate is illuminated by incident light, the refined measurement being performed by way of an electron microscope.

DETAILED DESCRIPTION

[0022] The high-accuracy measuring instrument **100** depicted in **FIG. 1** comprises a granite block **2** that is mounted in vibration-damped fashion on feet **3**. A measurement table **4** is supported on granite block **2** on air bearings **5**. It is also possible to use other bearings which can guarantee uniform and highly accurate displacement. Measurement table **4** is slidingly displaceable horizontally in two mutually perpendicular directions, indicated here by two arrows x and y, in directions X and Y. The drive systems for achieving the displacement are not depicted here. A mirror element **6** rests on measurement table **4**. Passing vertically and in stress-free fashion through mirror element **6** are three studs **7** with rounded ends, which project upward and downward. By way of studs **7**, mirror element **7** is supported on measurement table **4**. Studs **7** are arranged so that they result in a stable three-point contact for mirror element **6** on measurement table **4**, i.e. in this case two studs at the front left and right in the section plane, and the third stud at the center rear. In order for the contact surface to be kept optimally small, the lower ends of studs **7** are configured as spherical surfaces. Resting on the upper ends of studs **7** is a receptacle **8** having a frame-shaped depression into which a substrate **9** having features **19** is placed. It is also possible to place substrate **9** directly onto studs **7**. Integrated into mirror element **6** are the two measurement mirrors $\mathbf{13}_{mx}$ and $\mathbf{13}_{my}$ (the latter not depicted) for position determination using an interferometer **26** in the X and Y axes of measurement table **4**. In this example they are vacuum-deposited directly onto the material of mirror element **6**. Other possibilities for achieving a reflective surface are conceivable, and are sufficiently familiar to those skilled in the art. An interferometer measurement beam $\mathbf{14}_{mx}$ associated with the X axis, which is used for interferometric determination of the X position of measurement table **4**, is directed onto measurement mirror $\mathbf{13}_{mx}$ on mirror element **6**. A measurement mirror $\mathbf{13}_{my}$ (not depicted here) is integrated onto the rear outer side of mirror element **6**. Onto this is directed an interferometer measurement beam $\mathbf{14}_{my}$ associated with the Y axis (and also not depicted), which is used for interferometric determination of the Y position of measurement table **4**.

[0023] A lens **10** which defines an optical axis **11** is directed onto the surface of substrate **9**. A condenser **12**, which generates transmitted-light illumination when necessary, is arranged displaceably below substrate **9** on optical axis **11**. In order to make this transmitted-light illumination possible, granite block **2**, measurement table **4**, mirror element **6**, and receptacle **8** are equipped with frame-shaped openings around optical axis **11**. An illumination device **12**, which comprises an adjustable-height condenser **12***a* and a light source **12***b*, is set into granite block **2**. The exit surface of a light guide can also, for example, be provided as light source **12***b*. Condenser **12** aligns with optical axis **11** of lens **10**. The height adjustment capability of condenser **12** with light source **12***b* serves to adapt the illumination beams to be directed onto feature **9** to different optical thicknesses of various substrates **8**.