positions of the scan head (or for each of the plurality of the locations of the object), one of the plurality of detection signals or values derived therefrom is available in the memory for controlling the first actuator.

For example, first detection signals or values derived therefrom may have been obtained by the procedure described above and stored in the memory for a first set of positions of the scan head (or a first set of locations of the object). Before moving the scan head to a second position different from each position of the first set of positions of the scan head (or different from each position of the first set of locations of the object), the controller may calculate a prediction value for controlling the vertical movement of the first transducer relative to the scan head provided by the first actuator based on the first detection signals or values derived therefrom stored in the memory. Accordingly, even before moving the scan head to the second position where the object may not have been analyzed before, the first actuator may already be controlled according to the prediction value. Thereby, the first transducer can be brought into or close to the predefined working distance or the defocusing value may already be fairly small before/while the scan head is being moved to the second position. This reduces the amount of time required to properly arrange the first transducer with respect to the object when the object is scanned.

According to a further embodiment therein, for determining the prediction value for controlling the first actuator for a second position of the scan head, a sub-set of the detection signals or values derived therefrom stored in the memory may be used. The sub-set may be selected by the controller based on the distance between the second position and each of the first positions associated with one of the first detection signals/values derived therefrom. For example, the sub-set may be defined as to include the first detection signals/values derived therefrom associated with first positions, each having a distance to the second position which is less than a predefined threshold distance value. The predefined threshold distance value may be less than 1 µm, in particular less than 100 nm, or less than 10 nm. According to this embodiment, the first detection signals or values derived therefrom previously obtained at positions of the scan head that are close to the second position where the object is analyzed next are used for controlling the first actuator. For determining the prediction value, the sub-set may be processed using, for example, interpolation, extrapolation, etc.

transducer 11 to the surface 47 and the propagation time of a (reflected) second acoustic pulse from the surface 47 to the first transducer 11. That is, the distance H can be determined using the time of flight of an acoustic pulse emitted from the first transducer 11, reflected at the surface 47 and detected by the first transducer 11. Further parameters such as sonic velocity, a parameter describing the influence of a medium between the first transducer 11 and the object 3 (e.g. air or the immersion liquid 37) on the sonic velocity, a parameter describing the influence of material of the object 3 on the sonic velocity etc. may be stored in the memory 51 and used for determining the distance H. Accordingly, the controller 43 may be configured to determine a distance value representing the distance H and to control the first actuator 13 based on the determined distance value.

In particular, the controller 43 may be configured to control the first actuator 13 so that the distance H between the first transducer 11 and the object 3, in particular the distance between the first transducer 11 and the surface 47 of the object 3, approaches a predefined working distance $H_0$. In the example illustrated in FIG. 2, the predefined working distance $H_0$ is equivalent to the focal length of the first transducer 11, i.e. equivalent to the distance between the first transducer 11 and the focal point 20. This setup may be employed when the surface 47 of the object 3 is to be inspected where a particular analysis target 49 may be located.

As the controller 43 is configured to determine the distance value representing the distance H, the controller may be also configured to control the first actuator 13 to move the first transducer 11 relative to the scan head 9, and thus relative to the object 3, so that the distance H approaches the predefined working distance $H_0$.

Alternative to controlling the distance H to approach a predefined working distance $H_0$, the controller may be configured to determine a defocusing value representing a distance O between the focal point 20 and a location of interest of the object 3 based on the determined distance value H. In the example illustrated in FIG. 2, the location of interest coincides with the surface 47 of the object 3. However other locations within the object 3 may also be locations of interest.

For example, the controller 43 may store a value representing the focal length of the first transducer 11, i.e. the distance between the first transducer 11 and the focal point

# Claims

1. An ultrasonic microscope for inspecting an object,
wherein the ultrasonic microscope comprises:
an object holder configured to hold the object in an object region;
a scan head movable relative to the object region;
a first transducer supported by the scan head,
wherein the first transducer is configured to emit first acoustic pulses along an emission direction and to focus the first acoustic pulses in a focal point, and
wherein the first transducer is further configured to detect second acoustic pulses emerging from the object and to output a first detection signal representing the second acoustic pulses detected by the first transducer;
a first actuator configured to move the first transducer relative to the scan head along a vertical direction which is essentially parallel to the emission direction; and
a controller configured to:
- control vertical movement of the first transducer relative to the scan head provided by the first actuator based on the first detection signal– control emission of the first acoustic pulses by the first transducer,
– determine a distance value representing a distance between the first transducer and the object based on the first detection signal, and
– control the vertical movement of the first transducer relative to the scan head provided by the first actuator based on the determined distance value.

2. The ultrasonic microscope according to claim 1,
wherein the controller is further configured to:
– control the vertical movement of the first transducer relative to the scan head provided by the first actuator so that the distance between the first transducer and the object approaches a predefined working distance.

3. The ultrasonic microscope according to claim 1,
wherein the controller is further configured to:
– determine a defocusing value representing a distance between the focal point and a location of interest of the object based on the determined distance value, and
– control the vertical movement of the first transducer relative to the scan head provided by the first actuator based on the defocusing value.

4. The ultrasonic microscope according to any one of claims 1 to 3, further comprising:
a scan-head positioning device configured to move the scan head relative to the object holder in a lateral plane which is essentially orthogonal to the vertical direction.

5. The ultrasonic microscope according to claim 4,
wherein the controller is further configured to:
– control the scan-head positioning device so that the scan head is positioned at a plurality of positions,
– perform, each time the scan head is positioned at one of the plurality of positions, causing the first transducer to emit at least one of the first acoustic pulses, detecting at least one of the second acoustic pulses and outputting the first detection signal,
– store the first detection signals or values derived from the first detection signals in association with the plurality of positions, and
– control the vertical movement of the first transducer relative to the scan head provided by the first actuator based on a set of the stored first detection signals or derived values.

6. The ultrasonic microscope according to claim 4, further comprising:
a second actuator configured to move the first transducer relative to the scan head along a lateral direction which is essentially orthogonal to the vertical direction;
wherein the scan-head positioning device is configured to displace the scan head at most by a first displacement value;

wherein the second actuator is configured to displace the first transducer relative to the scan head at most by a second displacement value; and

wherein a ratio of the first displacement value to the second displacement value is at least 10.

7. An ultrasonic microscope for inspecting an object,

wherein the ultrasonic microscope comprises:

an object holder configured to hold the object in an object region;

a scan head movable relative to the object region;

a first transducer supported by the scan head,

wherein the first transducer is configured to emit first acoustic pulses along an emission direction and to focus the first acoustic pulses in a focal point, and

wherein the first transducer is further configured to detect second acoustic pulses emerging from the object and to output a first detection signal representing the second acoustic pulses detected by the first transducer;

a first actuator configured to move the first transducer relative to the scan head along a vertical direction which is essentially parallel to the emission direction;

a controller configured to control vertical movement of the first transducer relative to the scan head provided by the first actuator based on the first detection signal; and

a second transducer supported by the scan head so that the object region is located between the first transducer and the second transducer;

wherein the second transducer is configured to detect the second acoustic pulses emerging from the object and to output a second detection signal representing the second acoustic pulses detected by the second transducer.

8. The ultrasonic microscope according to claim 7, further comprising:

a second actuator configured to move the first transducer relative to the scan head along a lateral direction which is essentially orthogonal to the vertical direction; and

wherein the controller is further configured to control lateral movement of the first transducer relative to the scan head provided by the second actuator based on the second detection signal.

9. The ultrasonic microscope according to claim 8, wherein the controller is configured to control the lateral movement of the first transducer relative to the scan head provided by the second actuator so that the first transducer is aligned with the second transducer along the lateral direction.

10. The ultrasonic microscope according to claim 9, wherein the controller is configured to control the lateral movement of the first transducer relative to the scan head provided by the second actuator so that an intensity of the second detection signal is maximized.

11. The ultrasonic microscope according to claim 9 or 10, wherein the controller is configured to calculate a frequency-domain representation of the second detection signal and to control the lateral movement of the first transducer relative to the scan head provided by the second actuator based on the frequency-domain representation of the second detection signal.

12. The ultrasonic microscope according to any one of claims 7 to 11, further comprising:
a third actuator configured to move the second transducer relative to the scan head along the vertical direction.

13. The ultrasonic microscope according to claim 12, wherein the controller is further configured to control vertical movement of the second transducer relative to the scan head provided by the third actuator based on the first detection signal.

14. The ultrasonic microscope according to claim 13, wherein the controller is configured to calculate a control signal for controlling the vertical movement of the first transducer relative to the scan head provided by the first actuator based the first detection signal,
wherein the controller is further configured to control vertical movement of the second transducer relative to the scan head provided by the third actuator based on the control signal.

15. The ultrasonic microscope according to any one of claims 12 to 14, wherein the controller is further configured to control vertical movement of the second transducer relative to the scan head provided by the third actuator based on the second detection signal.

16. The ultrasonic microscope according to claim 15, wherein the controller is configured to control the vertical movement of the second transducer relative to the scan head provided by the third actuator so that an intensity of the second detection signal is maximized.

17. The ultrasonic microscope according to claim 15 or 16, wherein the controller is configured to calculate a frequency-domain representation of the second detection signal and to control the vertical movement of the second transducer relative to the scan head provided by the third actuator based on the frequency-domain representation of the second detection signal.

18. The ultrasonic microscope according to any one of claims 1 to 17, further comprising:
a fourth actuator configured to move the object holder relative to the scan head along the vertical direction; and
wherein the controller is further configured to control the fourth actuator so that the object can be variably positioned relative to the focal point in the vertical direction.

19. The ultrasonic microscope according to any one of claims 1 to 18,
wherein the first transducer is disposed above the object region.

20. The ultrasonic microscope according to any one of claims 1 to 19,
wherein the first transducer is configured to emit the first acoustic pulses so that the first acoustic pulses have an acoustic frequency above a threshold frequency, wherein the threshold frequency is selected from a group of threshold frequencies and the group of threshold frequencies comprises 10 MHz and 15 MHz.

21. An ultrasonic microscope for inspecting an object,
wherein the ultrasonic microscope comprises:
an object holder configured to hold the object in an object region;
a scan head movable relative to the object region;
a first transducer supported by the scan head, wherein the first transducer is disposed above the object region; and
an immersion apparatus configured to provide a first incessant connection of an immersion liquid between the first transducer and the object region.

22. The ultrasonic microscope according to claim 21, further comprising:
a second transducer supported by the scan head so that the object region is located between the first transducer and the second transducer;
wherein the immersion apparatus is further configured to provide a second incessant connection of the immersion liquid between the second transducer and the object region.

23. The ultrasonic microscope according to claim 21 or 22, wherein the immersion apparatus further comprises a receptacle for containing the immersion liquid,
wherein the receptacle is filled with the immersion liquid so that the object region is not located within the immersion liquid contained by the receptacle.

24. The ultrasonic microscope according to claim 21 or 22, wherein the immersion apparatus further comprises a receptacle for containing the immersion liquid,
wherein the receptacle is filled with the immersion liquid so that the object region is partially located within the immersion liquid contained by the receptacle.

25. The ultrasonic microscope according to claim 21 or 22, wherein the immersion apparatus further comprises a receptacle for containing the immersion liquid,
wherein the receptacle is filled with the immersion liquid so that the object region is fully located within the immersion liquid contained by the receptacle.

26. A carrier for carrying an acoustic pulse transducer of an ultrasonic microscope within an immersion liquid,
wherein the carrier comprises a first portion to be located within the immersion liquid and a second portion to be located outside the immersion liquid;
wherein the first portion comprises a solid structure having openings allowing the immersion liquid to flow through the first portion;
wherein a first value represents a total area of the openings in a cross section of the first portion,
wherein a second value represents a total area of the solid structure in the cross section of the first portion, and
wherein a ratio of the first value to the second value is greater than 5.

27. The carrier according to claim 26, wherein the first portion has in the cross section a length between 10 cm and 1 m.

28. The carrier according to claim 26 or 27, wherein the solid structure is shaped so that at least one of the following conditions is fulfilled:
essentially no lift is generated when the first portion is moved in the immersion liquid; and
essentially no drag is generated when the first portion is moved in the immersion liquid.