

The control means preferably comprises micro-processor means 102 electrically connected to the photodetector means to receive the output signals indicative of deflection of the laser beam from the optical lever arm means, and to generate the error signal indicative of a variance from the constant amount of force of the probe tip against the specimen surface. The control means is electrically connected to an electrical drive means 104 in the scanning means which is responsive to the error signal for raising and lowering the specimen with respect to the probe tip for increasing or decreasing the force of the probe tip against the specimen surface to maintain the substantially constant amount of force of the probe tip against the specimen surface.

In the preferred mode of the invention, means 110 for viewing the probe and adjacent surface contours of the specimen are disposed in accessory port 112 in the body of the microscope as well. An accessory objective optical device 114 or eyepiece is preferably provided in the accessory port to allow a user to view the probe and specimen. Although the accessory objective optical device preferably comprises one or more lenses focusing on the probe tip and cantilever arm, the accessory objective optical device may also include a charge couple device 115 mounted to the body adjacent to the bore and directed to image the probe means through the bore.

In one alternate preferred embodiment, the removable base 116 includes a chamber 118 which is dimensioned to receive a sealed cell 120 for containing the specimen. The sealed cell can be provided with a selected gas or liquid environment 122 for the specimen through ports 146a, b provided in the base for fluid transfer to the interior of the sealed fluid cell. The base includes an opening 124 for the optical path of the laser beam, with the opening being covered by an optical window 126, such as a thin pane of glass. The optical lever arm assembly includes the magnetic steel half washer member 128 magnetically secured to the body of the microscope, with the cantilever arm 130 mounted to the half washer member by an integral support member and bearing probe tip 132 extending into the fluid cell. The sample 134 is mounted on the stage 136, which in this embodiment includes an inner membrane seal 138 held in place in the fluid cell by a membrane frame member 142, and an outer O-ring seal 140 sealing the exterior of the fluid cell to the interior of the chamber of the base. The stage is in turn mounted on the lower piezo tube 144 of x, y, z scanning assembly, for raster scanning of the specimen and maintenance of a substantially constant force of the probe on the specimen.

It has therefore been demonstrated that the scanning force microscope of the invention provides for an improved mount for the probe of the microscope, which is easier to handle and install in the microscope. The improved mount also permits easier alignment of the laser beam onto the cantilever arm of the optical lever arm. The integrated optics of the microscope permits the user to view the approach of the lever arm and probe assembly to the surface of the sample to insure safe and precise positioning of the probe near the specimen. The scanning force microscope also includes the capability of receiving a sealed fluid cell for scanning a specimen in a fluid environment, which can significantly improve the quality of the image of the specimen produced by the instrument.

It will be apparent from the foregoing that while particular forms of the invention have been illustrated

and described, various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited, except as by the appended claims.

What is claimed is:

1. A scanning force microscope for examining surface contours of a specimen, comprising:
  - a stationary body;
  - scanning means for mounting of said specimen for examination by said scanning force microscope, said scanning means being secured to said stationary body and adapted to move said specimen in three degrees of freedom relative to said body;
  - optical lever arm means secured to said stationary body, said optical lever arm means including a reflective surface;
  - probe means secured to said optical lever arm means and including a probe tip adapted to contact and follow the surface contours of the specimen with a substantially constant amount of force;
  - laser light source means for producing a focused laser beam directed at and deflected by said optical lever arm means;
  - photodetector means for receiving said laser beam deflected by said optical lever arm means and generating an output indicative of a degree of deflection of said laser beam by said optical lever arm means, said photodetector means being mounted in said stationary body; and
  - means for viewing said probe means adjacent to said surface contours of said specimen, said means for viewing being disposed in said stationary body.
2. The scanning force microscope of claim 1, wherein said means for viewing comprises an accessory objective lens.
3. The scanning force microscope of claim 1, wherein said means for viewing comprises a charge couple device.
4. The scanning force microscope of claim 1, wherein said optical lever arm means comprises a reflective cantilever arm.
5. The scanning force microscope of claim 4, wherein said probe means is mounted to a free end of said cantilever arm.
6. The scanning force microscope of claim 1, wherein said photodetector means includes a photodetector mounted to said body, and further including mirror means mounted within said body to deflect said laser beam from said optical lever arm means to said photodetector.
7. The scanning force microscope of claim 1, wherein said means for viewing comprises a bore through said body directed at said probe means, and an objective optical lens disposed in said bore focused on said probe means.
8. The scanning force microscope of claim 1, wherein said means for viewing comprises a bore through said body directed at said probe means, and a charge couple device mounted to said body adjacent to said bore and directed to image said probe means through said bore.
9. The scanning force microscope of claim 1, wherein said stationary body comprises a removable base having a chamber for receiving said specimen.
10. The scanning force microscope of claim 1, wherein said optical lever arm is magnetically secured to said body.
11. The scanning force microscope of claim 10, wherein said optical lever arm comprises a magnetic