convergence to another more convenient position. Lens **110** may also be used for adjusting the size of the reflected laser beam **102** so that it is optimized for the position sensitive detector **16**. It is of course possible to use other lenses using standard optical practice to adjust the rate of convergence of beams **102** to make the convergence point **104** occur at other desired locations. A mirror could also be used in this embodiment anywhere between the cantilever and the position sensitive detector in the same manner as shown in FIG. **11** to direct the point of convergence to a different position.

FIG. **13** shows an alternate embodiment that uses a single concave mirror **120** to redirect the point of convergence shown in FIGS. **11–12** to a more convenient position. In this case the single concave mirror **120** replaces the flat mirror **103** shown in FIG. **11** and the relay lens **110** shown in FIG. **12**.

A method of operating the AFM according to present invention will now be described. As shown in FIG. **4**A, for example, a light beam is generated and then directed onto cantilever **14** using optical assembly **43** so that the light beam strikes substantially a fixed point on cantilever **14**, during movement of the scanning mechanism. The striking of substantially a fixed point is illustrated in FIG. **13**, where light beams **101** strike cantilever **14** while it is scanned across sample 13. The light beam reflected from cantilever **14** (**47** in FIG. **4***a*) is received by position detector **16** which can detect deflections of cantilever **14**.

Also illustrated in FIG. **4**A is the splitting of beam **44** using splitter **45** and the cut out in mounting member **42** (FIG. **4**B) to allow access of an optical microscope **46**, while in FIG. **7** the beam **68** is split using splitter **65** to direct a portion of the the beam **68** to a second position detector **66**.

FIG. **14** is a flowchart of a modification of the method of the invention where the location of the position detector is determined. First, in step **14-1**, the light beam reflected from the cantilever is measured while the scanner **12** is scanned over a full extent of its movement on a very flat surface or while actually not touching any sample. The change in position in the measured signal is then determined using position sensitive detector **16** (step **14-2**). The amount of change in this signal is a measure of the amount of "false deflection" being seen by the system. The position sensitive detector is then moved closer or further from the cantilever (along the optical axis of the reflected beam) and the scanning process repeated (step **14-3**) a desired number of times until these "false deflections" are minimized (step **14-4**). Position detector **16** is then placed at this location of minimum change (step **14-5**).

While the invention has been described with reference to several specific embodiments, those skilled in the art will be able to make various modifications to the described embodiments without departing from the true spirit and scope of the invention. For example, an AFM that scans using other optical elements such as prisms instead of lenses or mirrors, or other combinations of such elements to keep the laser focused on a scanning cantilever, is within the intended scope of the invention. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

Although what has been described is a contact AFM, where the stylus is in constant contact with the surface, the described invention can also be used in applications where the cantilever is oscillated, such as magnetic force microscopy (Martin and Wickeramasingle, Appl. Phys. Lett., 50, pg. 1455 (1987), Non-contact Topography, Durig et al, Phys. Rev. Lett., 53, p. 1045, (1988)) and as a jumping probe microscope where the stylus is repeatedly lifted off the surface during a scan (U.S. patent application Ser. No. 08/009,076 now U.S. Pat. No. 5,266,801).

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An atomic force microscope, comprising;

a scanning mechanism;

an optical lever system including,

a light source not moved by said scanning mechanism,

a cantilever moved by said scanning mechanism so that said cantilever may be scanned over a sample, and

a position detector not moved by said scanning mechanism which receives reflected light from said cantilever and detects an angular deflection of a free end of said cantilever;

an optical assembly to guide light emitted from said light source onto the cantilever to follow substantially a fixed position on said cantilever during movement of said scanning mechanism; and

an element having a light-transparent region, connected to and translated by said scanning mechanism, said element having an upper surface and a lower surface transmissive to light from said light source, said upper surface being out of contact with fluid, if any, on a sample to be scanned by said atomic force microscope, and said lower surface being exposed to contact with fluid, if any, on said sample.

2. An atomic force microscope as recited in claim **1**, wherein said upper surface and said lower surface are parallel to one another.

3. An atomic force microscope as recited in claim **1**, wherein said upper surface, said lower surfaces and said cantilever are at substantially the same angle with respect to said scanning mechanism.

4. An atomic force microscope as recited in claim **1**, wherein said element is plastic or glass.

5. An atomic force microscope as recited in claim **1**, wherein said element is positioned between said light source and said cantilever whereby light from said light source passes through said element to impinge on and reflect from said cantilever.

6. An atomic force microscope as recited in claim **1**, wherein at least one surface of said element is parallel to said cantilever.

7. An atomic force microscope comprising:

a scanning mechanism; and

an optical lever system including,

a light source not moved by said scanning mechanism,

an element with an optically transparent region included on said scanning mechanism so that said element may be translated by said scanning mechanism, a cantilever mechanically coupled to said element and said scanning mechanism so that said cantilever may be scanned over a sample, and

a position detector not moved by said scanning mechanism and which receives reflected light from said cantilever;

said atomic force microscope further comprising an optical assembly to guide light emitted from said light source onto the cantilever to follow substantially a fixed position on said cantilever during movement of said scanning mechanism.

8. An atomic force microscope as recited in claim **7**, wherein said optical assembly comprises means for producing a point source of light between a fixed end and said free end of said scanning mechanism.

9. An atomic force microscope as recited in claim **7**, wherein a stylus is included substantially on the free end of said cantilever.