

It is a further object of the present invention to provide a humidity chamber suitable for use with a scanned stylus AFM which allows precise control of relative humidity.

These and other objects are achieved according to the present invention by providing a new and improved a humidity chamber which can be used to provide a humidity-free environment, or alternatively a humidity intense environment (humidity level can be maintained at a specified level) suitable for use with a scanned stylus AFM. The invention generally comprises a chamber within which the AFM scanning head assembly is placed, and an integrated sample platform and spring-loaded base-plate that allow samples to be loaded and unloaded without removal of the humidity chamber from the AFM scanning head assembly. Once the sample platform is positioned inside the chamber, a locking clip is inserted between the chamber and the bottom portion of the sample platform to secure the sample platform and base-plate. The spring-loaded base allows the z-directional motors of the AFM to be used to position the sample just below the AFM scanning tip (probe) prior to scanning, while at the same time providing a snug fit between the chamber and the AFM scanning head.

In an embodiment of the present invention, the humidity chamber comprises a chamber of specified geometry within which the AFM scanning head assembly is placed, and an integrated sample platform and spring-loaded base-plate which allow samples to be loaded and unloaded without removal of the chamber from the AFM scanning head assembly.

In an embodiment of the present invention, the humidity chamber comprises a chamber of specified geometry which allows the use of an optical system to locate and focus on a probe and/or sample surface.

In an embodiment of the present invention, the humidity chamber includes adjacent entry and exit ports that allow humid air to be delivered into the chamber, fill the chamber, and exit the chamber.

In an embodiment of the present invention, the sample platform extends up from the base-plate and is inserted into the chamber, and includes a magnetic sample port comprising a magnet securely attached to the base-plate.

In an embodiment of the present invention, a locking pin secures the sample platform and base-plate once the sample platform is positioned inside the chamber.

In an embodiment of the present invention, the humidity chamber includes a port configured to allow for the use of an optical system.

In an embodiment of the present invention, the humidity chamber includes a large side-entry port configured to allow access to an optical microscope lens.

In an embodiment of the present invention, one or more of the AFM scanner, tip assembly (probe), optical lever detection system, sample, and side-mounted optical microscope objective lens (camera) are fully enclosed.

In an embodiment of the present invention, a magnetic sample port is configured to provide a snug fit between the chamber and the AFM scanning head assembly.

BRIEF DESCRIPTION OF DRAWINGS

A more complete appreciation of the invention and the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIGS. 1 and 2 provide prospective views of the humidity chamber of the present invention. In FIG. 2, the integrated sample platform and base are shown removed from the chamber.

FIGS. 3–6 provide block views of the top, sides, and front of the humidity chamber of the present invention.

FIGS. 7–11 provide engineering drawings of an embodiment of the humidity chamber of the present invention configured to accommodate a scanned-stylus AFM having an optical lever such as that described in U.S. Pat. Nos. 6,032,518; 5,714,682; 5,560,244; and 5,463,897.

FIGS. 8–10 provide engineering drawings of the integrated sample platform and base (the spring positions and magnet are not shown).

FIG. 11 provides an engineering drawing of a securing plate used to mount a rubber strip used as a seal around the optical microscope lens.

DETAILED DESCRIPTION OF THE INVENTION

The present invention comprises a humidity chamber which can be used to provide a humidity-free environment, or alternatively a humidity intense environment in which a specified humidity level can be maintained. The humidity chamber of the present invention is suitable for use with an atomic force microscope (AFM), or other commercially available microscopes. A preferred embodiment of the humidity chamber of the present invention employs an intricate geometrical design which accommodates a scanned-stylus AFM having an optical lever such as that described in U.S. Pat. Nos. 6,032,518; 5,714,682; 5,560,244; and 5,463,897. The geometrical design of the humidity chamber of the present invention allows the AFM scanner, tip assembly (probe), optical lever detection system, sample, and if necessary, a side-mounted optical microscope objective lens (camera), to be fully enclosed without degrading significantly the ability to operate the AFM or the related systems.

The invention generally comprises a means for using, and for accessing, an optical system to locate and focus on one of more of a probe and a sample surface, the means preferably including, but not limited to, a chamber within which the AFM scanning head assembly is placed, an integrated sample platform, and a spring-loaded base-plate that allows samples to be loaded and unloaded without removal of the chamber from the AFM scanning head assembly. Once the sample platform is positioned inside the chamber, a locking pin can be inserted between the chamber and the bottom portion of the sample platform to secure the sample platform and base-plate. The invention includes means for using an optical system to locate and focus on one or more of a probe and sample surface, the means preferably including, but not limited to, a spring-loaded base which allows the z-directional motors of the AFM to be used to position the sample just below the probe prior to scanning while at the same time providing a snug fit between the chamber and the AFM scanning head. An embodiment of the present invention is also suitable for use with a means for controlling relative humidity, such as a humidity-generating device, (for instance, the humidity generator manufactured by VTI Corporation), which allows precise control of relative humidity. Use of the invention with a humidity generating device has shown large differences in force measurements made on mica at several different humidity levels. An embodiment of the present invention is also suitable for use with a means for sensing relative humidity, such as a commercially available humidity-sensing device, (for instance, the Thin-Film Capacitance Sensor manufactured by Vaisala).

An embodiment of the present invention is shown in FIGS. 1 through 11. Specifically, FIGS. 1 and 2 present