particularly lower wavelength radiation such as ultraviolet radiation. The property that is affected may include, for example, any change observable on a molecular level. Such properties include any property that may be spectrographically measured, such as, for example, using IR spectroscopy, UV spectroscopy, NMR spectroscopy, or other methods. The property that is affected also may be any property that may be macroscopically observed, such as, for example, changes in color, appearance, strength, weight, conductivity, or any other physical property.

To irradiate a specimen, the specimen may be placed within the integrating sphere. Preferably, however, the specimen is disposed within a specimen holder that is itself disposed externally with respect to the integrating sphere. As shown in FIGS. **1**–**3**, a specimen holder **32** or **32'** may be attached to the integrating sphere **11** at the exit aperture **14**. In accordance with the preferred embodiment of the invention, plural specimen holders **32**, **33**, **34**, as shown in FIG. **2**, are in radiative communication with the integrating sphere **11** to allow simultaneous irradiation of plural specimens. The specimen holder may be any container or retaining device to retain a specimen in radiative communication with the integrating sphere **11**. Preferably, each of the specimen holders **32**, **33**, **34** comprises an enclosed or substantially enclosed chamber, such as an aluminum box, whereby the environmental conditions within the chamber may be controlled and monitored. Each of the specimen holders **32**, **33**, **34** preferably is removable from the apparatus so that substitution of new specimens disposed within new specimen holders may be easily accomplished. Inasmuch as the irradiance of radiation impinging on the specimen from a point source will decrease inversely as the square of the distance of the specimen from the radiation source, the specimen holders are preferably equidistant from the apertures.

In accordance with the most preferred embodiment, the apparatus has components for independently controlling at least one environmental condition within each of the specimen holders. For example, as shown in FIG. **2** with respect only to specimen holder **32**, the apparatus may include means **37** associated with one or more of the specimen holders for controlling the temperature within the specimen holder **32**. Such temperature control means may comprise, for example, heating and/or cooling coils, or may alternatively comprise a ventilation system for introducing hot or cold air into the specimen holder **32**. The apparatus may further include means **38** for controlling the ambient humidity within the specimen holder **32**. Such means **38** may include, for example, a source of moisture or a ventilation system for introducing air of a predetermined level of humidity into the specimen holder **32**. In another embodiment of the invention, the apparatus may include means **40** for applying a static or cyclically varying mechanical load to a specimen disposed within the specimen holder **32**. Such means may comprise, for example, tensioning grips, compression grips, bending devices, and the like. Those of ordinary skill in the art will appreciate that other components for controlling these and other environmental conditions within the specimen holders may be provided. In addition, the specimen holders may include sensors (not shown) for monitoring environmental conditions such as temperature and humidity therewithin to assist an operator in controlling the environmental conditions within the specimen holder.

If it is desired to place a specimen or specimens within the integrating sphere, the integrating sphere may itself be provided with similar components for controlling an environmental condition within the sphere or within a portion of the sphere that retains an irradiated specimen. For example, the interior of the integrating sphere may include one or more specimen holders, and one or more of the specimen holders may be provided with means for controlling an environmental condition therewithin.

The specimen holders may be attached directly to the integrating sphere at the apertures. In this embodiment, couplings (not shown) such as bolts or screws or other optical mounts may be used to removably fasten the specimen holders to the integrating sphere. In a preferred embodiment of the invention, however, the specimen holders are not attached directly to the integrating sphere, but instead are in radiative communication with the integrating sphere through a conduit, which itself preferably is attached directly to the integrating sphere. A conduit in accordance with the invention may be any instrumentality that permits radiation emitted from an aperture in the integrating sphere to be communicated to a specimen holder, preferably while allowing the radiance uniformity of a beam of such radiation to be maintained. The prior art is not known to teach or suggest the use of such a conduit. Use of a conduit increases the flexibility of the design of the apparatus, inasmuch as the conduit allows a greater number of specimens to be irradiated and facilitates specimen removal and maintenance of the apparatus.

For example, as shown in FIG. **4**, the conduits **43** each may comprise a fiber optic connection **45**, including one or more fiber optic cables, for communicating light from the sphere **11"** to specimen holders **32"**, **33"**, **34"**. The conduit may alternatively comprise a "light pipe," or radiation guide (not shown). In another embodiment of the invention, as shown in FIG. **3**, each conduit **43'** comprises a cylindrical tube, preferably a right circular cylindrical tube. FIGS. **5** and **6** illustrate one embodiment of a cylindrical tube **43'** in accordance with the invention, as shown assembled with a specimen holder **46**. Couplings (not shown) such as screws or bolts or other optical mounts may be used to removably fasten the specimen holder **46** to the conduit **43'** and/or the conduit **43'** to an integrating sphere. The inner surface **47** of the tube preferably is mirror-like and may comprise, for example, polished aluminum. Preferably, the inner surface **47** is not diffusely reflective.

In a highly preferred embodiment of the invention, the conduit comprises a high collection, non-imaging optic device, such as compound parabolic cone concentrator **48**, as shown in FIGS. **7** and **8**. A compound parabolic cone concentrator, often referred to in the art as a Winston cone, is a non-imaging concentrator having an interior surface defining a surface of revolution of complex geometry. As shown in FIG. **8**, the interior wall **49** of the compound parabolic cone concentrator **48** comprises a surface of revolution of an off-axis parabola. The surface geometry of such cones reflect and concentrate radiation while maintaining spatial uniformity of radiant energy flux over the cross-section of the cone. Physical principles of such cones are discussed in Welford et al., *The Optics of Nonimaging Concentrators: Light and Solar Energy* (1978) and Welford et al., *High Collection Nonimaging Optics* (1989). Such cones have heretofore been used in conjunction with light collection in optical systems. When used in accordance with the apparatus of the present invention, radiant energy flux is concentrated while retaining flux uniformity across a cross-section normal to the beam. The end **50** of the cone **48** having the smaller cross-section preferably is connected to the specimen holder and the other end of the cone preferably is connected to the integrating sphere.