index of the surrounding region. In a typical example where a sensor portion had a length of 10 cm, the amount of light lost was of the order of 9%. This is because the majority of the cladding layer remains in place along the sensor portion, and the portions of the cladding layer between the scratches **20** will retain light inside the fiber core. Light can escape only through the roughened portions or scratches **20**, enhancing the sensitivity of the device.

In one specific example of the invention, the optical fiber had a core diameter of 1 mm and a plastic cladding layer diameter of 1.035 mm. The length of the sensor portion over which the outer protective layer is removed may be between 2 cm to the entire length of the fiber, depending on the quantity to be measured and the type of medium in which the sensor portion is to be immersed.

The sensor element **10** is capable of detecting a very small change in the refractive index of a medium into which the sensor portion **32** is immersed, and can be used in liquid, gaseous, or granular solid media. In addition to detecting humidity changes in air, it may also be used in other applications. The sensor fiber is of glass, and is therefore chemically inert and mechanically rugged, so the device can be used in hostile, volatile and corrosive environments without breakdown. There are numerous other possible applications, such as car battery monitoring, liquid refractometer, cement drying monitor, agricultural product humidity monitor, baking monitor, soil water and contaminant detection, water and icing detector, exhaust gas monitoring, and sugar content monitoring.

In order to monitor a car battery's chemical composition as the battery ages, the sensor fiber of this invention may be immersed in the battery liquid. This provides an indication of the condition of the battery.

The sensor fiber may also be used as a liquid refractometer to provide a convenient and accurate measurement of the index of refraction of a liquid, chemical solution, or solvent into which the sensor portion of the fiber is immersed.

In a construction site, the poured cement needs to be monitored to determine whether it is sufficiently dried before additional work can be built upon it. The fiber sensor of this invention can serve as a disposable probe to be buried in wet cement and monitor its drying.

The fiber sensor may also be inserted into a pile of grain or other agricultural products to detect humidity inside the pile. Another possible application is in monitoring humidity inside a baking oven, such as a bread baking oven or an oven used in tobacco processing. The fiber sensor is sufficiently rugged to be used in such an application.

The fiber sensor may also be submerged into soil to detect water and contaminants. It may also be used to monitor exhaust gas in a car exhaust pipe, for example. Exhaust gases resulting from incomplete combustion will contain more pollutants will have a different refractive index from exhaust gases resulting from efficient combustion, and the sensor device can therefore differentiate between these different types of exhaust gases. The sensor may also be used to monitor sugar content in a solution, since the refractive index of the solution will vary with changes in sugar content.

There are many other possible applications for the sensor device and system of this invention. The sensor device may be used to monitor any medium to detect changes in refractive index which may result from change in humidity or water level, change in pollutant levels, changes in chemical composition, and the like. The sensor device of this invention is relatively inexpensive, yet provides a sensitive measurement of any change in refractive index of a surrounding medium, and thus of the property which caused that change. Although other possible applications are discussed above, this device is particularly useful as a humidity sensor, where the change in refractive index may be relatively small. Other known humidity sensors are expensive to manufacture and slow to respond to humidity changes. The sensor device of this invention, if used as a humidity sensor, is relatively inexpensive yet very accurate, even in detecting relatively small changes in humidity.

Although a preferred embodiment of the present invention is described above by way of example only, it will be understood by those skilled in the field that modifications may be made to the disclosed embodiment without departing from the scope of the present invention, which is defined by the appended claims.

We claim:

1. A sensor device, comprising:

a length of optical fiber having a core, a cladding layer surrounding the core, and an outer protective layer;

at least a portion of the length of the optical fiber having the outer protective layer removed to expose a portion of the cladding layer;

the exposed portion of the cladding layer being roughened, whereby a part of the light propagating through the core will be lost through the exposed, roughened portion of the cladding, the amount of light lost being dependent on the refractive index of a medium surrounding the exposed portion of the cladding layer; and

the exposed portion of the cladding layer extending along a part of the length of the optical fiber, and the outer protective layer covering the cladding layer on each side of the exposed portion.

2. The device as claimed in claim **1**, wherein the exposed portion has a length of at least 1 cm.

3. The device as claimed in claim **1**, wherein the cladding layer has a thickness of about 35 micron and the surface of the cladding layer is roughened with a grinding powder having an abrasive size of about 40 micron.

4. The device as claimed in claim **1**, wherein the cladding layer is of predetermined thickness, and the roughened portion has scratches of depth no greater than the thickness of the cladding layer.

5. The device as claimed in claim **4**, wherein at least some of the scratches are of depth equal to the depth of the cladding layer, whereby portions of the outer surface of the core are exposed, the exposed portions being smooth and non-roughened.

6. A sensor system, comprising:

a light source;

an optical fiber having a first end positioned to receive output light from the light source, and a second end;

the optical fiber having a light transmitting core, a cladding layer surrounding the core, and an outer protective layer, the outer protective layer being removed along at least part of the length of the fiber to expose a portion of the cladding layer;

the exposed portion of the cladding layer being roughened to produce a plurality of surface scratches extending through at least part of the thickness of the cladding layer, whereby the exposed, roughened portion of the cladding layer forms a sensor region through which light is lost from the core; and

a photodetector connected to the second end of the optical fiber for detecting the amount of light transmitted through the fiber and producing an output signal proportional to the amount of light transmitted;