

## The Principles of Operation for Aluminium Oxide Moisture Sensors

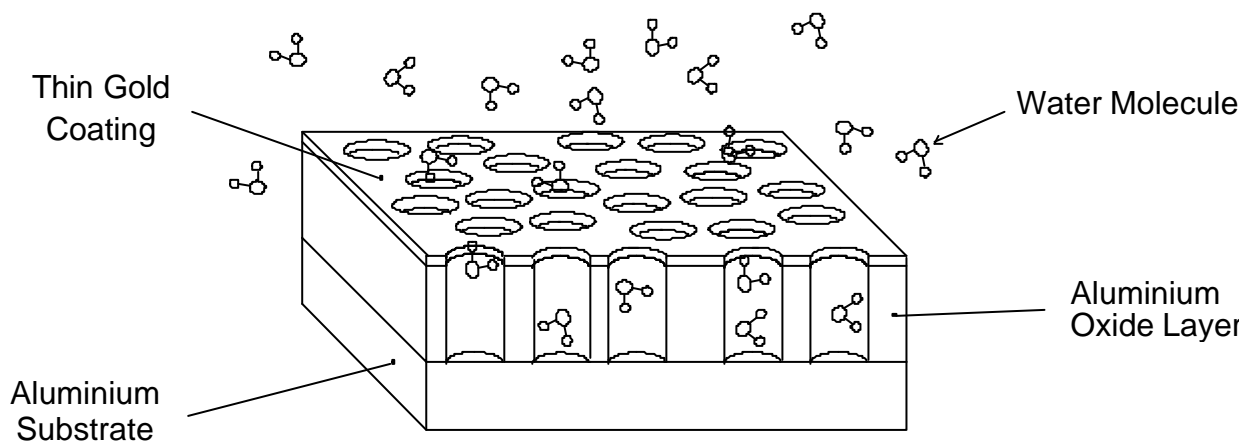
The Aluminium Oxide moisture sensor was originally invented within the Ministry of Agriculture, Fisheries and Food, Aberdeen, and was introduced to the outside world in a paper published in 'Nature, Vol 171, p. 177, January 24th 1953'. The sensor's potential was recognised by an eager industry and has become the standard method of trace moisture measurement. The mantle has now been taken on by Xentaur, who have developed the technology into a precise, stable and reliable method of moisture measurement.

To manufacture an Aluminium Oxide sensor is relatively easy. The problem is producing a quality sensor with minimal drift, and a high capacitance, ensuring stability and sensitivity, with good repeatability. The highest standards of manufacture are required, with rigorous quality control.

In the manufacture of the Xentaur sensor, the two most critical areas are the quality of materials used, and the quality of the environment in which they are made. Firstly the purest Aluminium is oxidised in a highly controlled manner. This is to grow the 'tubules' where the moisture enters. A very fine coating of gold is vapourised onto the surface of the hyper thin oxide coating. The elements of a capacitor are now in place; the aluminium substrate and the gold act as the electrodes, with the oxide as the dielectric.

### Aluminium Oxide Sensor

#### In Section



The water molecule is highly polarised; this gives rise to an exceedingly high dielectric constant at least an order of magnitude greater than any other common gas or liquid. The tubules in the Aluminium Oxide are just large enough for the water molecule to penetrate, but too small for just about anything else. As water molecules enter, the dielectric value of the sensor increases- the more water, the greater the capacitance. The amount of water molecules in the oxide layer is directly proportional to the partial water vapour pressure in the gas/liquid being analysed. Water vapour pressure is in turn inextricably linked to Dewpoint.

If the overall pressure exerted by the measured medium increases, this in turn proportionally increases the water vapour pressure, according to Dalton's Law. The higher the pressure, the more water molecules are pushed into the sensor, and accordingly the capacitance increases. The total water content has not changed yet the sensor will register it as such. It is therefore imperative that pressure compensation is used when aluminium oxide is measuring in absolute units, and at pressure. All Xentaur instruments can not only measure in a wide range of units but also have the ability for internal pressure compensation.

Despite the Xentaur's Hyper Thin Film technology giving the advantage of a high capacitance sensor, the precise measurement of the dielectric is still critical if the overall integrity of the measurement is to be valid. Xentaur employs two audio quality transformers coupled by the sensor: one producing a square wave through a band pass filter, the other driving a RMS converter through a band pass filter. The RMS converter in turn drives an A/D converter. This gives rise to an accurate and reliable package; low noise and high gain.

Although the principles of Aluminium Oxide moisture measurement are cast in science, the quality of manufacture and use of the instrument will dramatically affect the performance of your system - for you moisture requirements please contact IMA.