How Does a Monitor Measure Thickness?

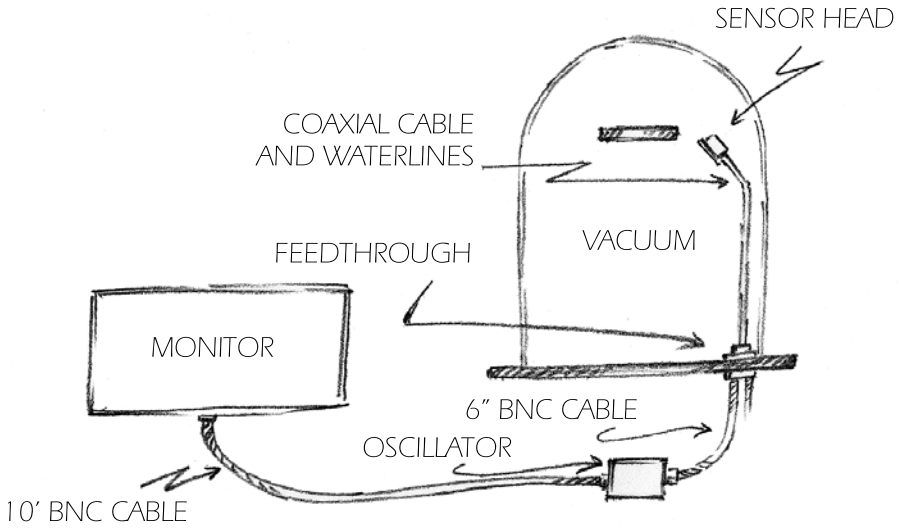
Once a quartz crystal is placed inside a sensor head in a vacuum chamber, the only indication that the crystal is working properly comes from the thin film monitor, or if the process is run automatically, a thin film controller. So, what does a thin film monitor do, anyway?

A thin film monitor uses several electronic components to cause the crystal in the chamber to vibrate at approximately 6 million times per second (or 6 Megahertz), count the change in the number of vibrations per second as the coating deposits on the crystal and, calculate the thickness of the coating from the data it receives. Most monitors can accomplish these tasks many times per second; giving the operator a continuous measurement of how fast the coating is being deposited on the crystal and the substrates in the chamber.

In order to cause the crystal to vibrate at 6 MHz, the monitor uses an "oscillator" which is located outside the vacuum chamber and electrically connected to the monitor and the crystal sensor feedthrough. The oscillator applies a quickly changing electrical charge to the crystal, causing the crystal to vibrate. An electrical signal is then sent back to the monitor.

Circuits inside the monitor receive the electrical signal and count the crystal vibrations each second. This information is relayed to a microprocessor that calculates and displays on the monitor: 1) the coating rate in Angstroms per second; 2) the total thickness coated since the beginning of the process; 3) the "life" of the crystal, a measure of how much the crystal vibrational rate has changed since it was new; and, (4) the total elapsed time since the coating process began. More sophisticated units also show a graphical display of the coating rate versus time, as well as an indication of the film type being deposited.

Many factors can also be programmed into the monitor to allow highly accurate measurement and control of the film coating process. Operators can program: 1) the desired coating thickness or the maximum coating rate; 2) the density of the film being coated; 3) the tooling factor, a correction for the position of the crystal in relation to the position of the parts being coated; and, 4) the "Z" value, or acoustic impedance. (The acoustic impedance only applies when a coating is very thick, more than 10,000 Angstroms, and is a correction for the way the crystal vibrates when a thick film is on it. In most optical coating processes "Z" can be entered as "1".)



TYPICAL SYSTEM

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