Effect of Electrode Material on Quartz Crystal Performance

The contact electrode material of a quartz crystal creates a pronounced effect on the crystal's ability to measure film thickness.

INFICON manufactures four standard crystal coatings: gold, longer-life gold®, stress-relieving alloy®, and silver.

Gold Electrode Crystal

Gold electrode crystals are the most widely known electrode material. It offers low contact resistance, high chemical stability, and is easy to deposit. Typically, gold crystals are used for low-stress metal depositions, such as gold, silver, and/or copper. With gold, it is possible to get frequency shifts of up to 1 Megahertz without adverse effects. However, gold electrodes are relatively inflexible, transmitting stresses from deposited films to the underlying quartz. Transmitted stress may result in frequency jumps and crystal instability.

Alloy Electrode Crystal

Stress-relieving alloy is the best electrode for high-stress material depositions including: silicon monoxide, silicon dioxide, magnesium fluoride, and titanium dioxide. Deposited high-stress materials often cause erratic crystal performance produced by high tensile or compressive stresses. These stresses cause bending of the quartz and subsequent frequency shifts.

Stress-relieving alloy dissipates the stress of the deposited film by plastic yielding or flowing. Long before the compressive or tensile forces cause the crystal to bend, the electrode will "give," dissipating the stress. This results in a much more stable crystal with a longer period of steady, jump-free oscillation. Laboratory experiments have shown as much as a 400% increase in crystal life with deposited silicon dioxide on stress-relieving alloy.

Silver Electrode Crystals

Silver is an excellent all-around electrode material. Silver has a low contact resistance and exhibits some degree of plastic yielding. However, silver tends to tarnish in the presence of atmospheric sulfides. Tarnish increases contact resistance and decreases the adherence of films deposited on the crystal.