

# Effect of Electrode Metal on Quartz Crystal Sensor Performance

The type of metal used for the contact electrode on a quartz crystal has a pronounced effect on the crystal's ability to measure film thickness. As a result, Fil-Tech provides four standard crystal coatings: **Gold, Longer Life Gold, Stress Relieving Alloy, and Silver.**

**Gold** is the mostly 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 stresses may result in frequency jumps and crystal instability.

**Stress Relieving Alloy**, an aluminum-silver composition, 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.

**Longer Life Gold** crystals are exclusive to Fil-Tech and offer longer life than standard gold crystals. Fil-Tech's proprietary process for Longer Life Gold combines the low contact resistance and high chemical stability of gold crystals with the plastic yielding qualities of Stress Relieving Alloy crystals to produce a superior, Longer Life Gold crystal. Fil-Tech recommends our Longer Life Gold for anti-reflective coatings and semiconductor processes to dissipate the stresses caused by dielectric and high stress material depositions. Laboratory experiments have shown over 200% increase in crystal life with deposited magnesium fluoride on Longer Life Gold.

**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 will increase contact resistance and decrease the adherence of films deposited on the crystal.

RESULTANT STRESS TRANSMITTED BY CRYSTALS TO MONITOR



Gold



SILVER



STRESS RELIEVING  
ALLOY



DIELECTRIC AND/OR  
HIGH-STRESS METAL DEPOSITION

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