Application Note

Care and Handling of Quartz Crystals

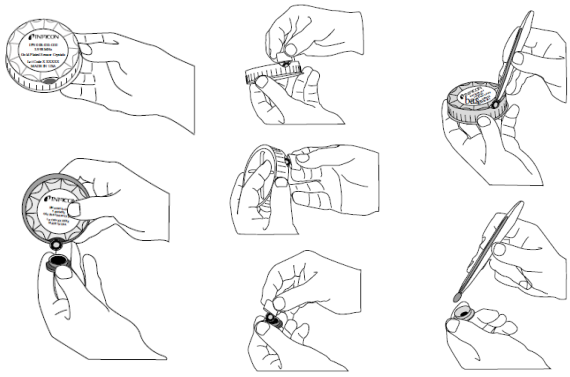
A quartz crystal is arguably one of the most sensitive electrical devices ever invented.

When used for thin film coating measurements, a crystal can detect as little as a picogram or 0.000000000001 gram of deposited material. This corresponds to a coating layer on the order of one atom thick. Quartz is also sensitive to heat, able to respond to temperature changes of less than one-one hundredth of a degree. Quartz crystals are sensitive to stress, able to detect the movement when films cool after being deposited on the crystal during a typical optical coating run.

With a device this sensitive operating in high-stress coating environments, you have to ask, "How can it work?" Our answer is, "Just barely!" A typical antireflective coating with magnesium fluoride, zirconium, or chromium, hits the crystal doubly hard with high temperatures in excess of 300°C and high stresses from the film as it cools only the crystal. It is not uncommon to see a crystal act erratically by exhibiting large positive and negative jumps in rate or thickness, after just a few minutes exposure to MgF_2. These materials can also easily destroy a crystal.

In order to get the maximum life out of quartz crystals, the following guidelines are recommended:

1. Always use plastic tweezers around the edge of the crystal during handling. Do not touch the center of a crystal, as any oil, dirt, dust, or scratches will quickly degrade the ability of the crystal to oscillate.
2. Keep the crystal holder clean. Do not allow material particulate to come into contact with the center of the crystal, front or back. Any material buildup that comes between the crystal and the cap interferes with the electrical contact and develop stress points, affecting the crystal's fundamental oscillation.
3. In order to promote better film adhesion, maintain the cooling water to the sensor head below 30°C. The hotter the deposition, the closer the crystal should run to between 55 and 85°C. Whatever the temperature, keeping the temperature stable, to within 1-2°C, gives superior results. The range described minimizes the frequency shift of the crystal due to change in temperature. This ensures that the accuracy of the measurement is optimized and only reflects true material accumulation.



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