MIDWEST TUNGSTEN SERVICE

Tips

How Thick Is The Film?

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Most batch vacuum metallizers do not have the equipment necessary to measure aluminum film thickness. Occasionally, someone will ask how thick the deposited film is and if a thicker coating will help. If you are coating for decorative purposes, the information below should suffice in most situations. We have prepared a brief chart showing approximate film thickness in angstroms and how you can estimate this from the appearance of the part. This is certainly not as accurate a determination as could be achieved with a crystal film thickness monitor or other measuring devices, but should get you in the ballpark.

An angstrom approximately the width of an atom. Obviously, we can't perceive this directly so the term is meaningless without a frame of reference. The chart below will give you an idea of how different angstrom thicknesses appear when deposited on a clear substrate. The angstrom unit is no longer the favored unit in scientific circles. The favored unit at this time is the nanometer, which is equal to 10 angstroms.

SEE THROUGH	ANGSTROM THICKNESS	REFLECTIVITY
Very Well	50	Slight
Very Well	150	About 40%
Slight Dimming	250	About 50%
Some Opacity	450	Good Reflectivity
Opaque	600	Maximum Reflectivity
Maximum Opacity	900	Slight Loss
No Change	1200	Slight Loss

1 angstrom = .0039 millionths of an inch
1 angstrom = 10^{-10} meters

As you will note, a small amount of evaporated aluminum is not going to give very good results. On the other hand, once you achieve a certain thickness there is no benefit in additional deposition. As a matter of fact, if the thickness becomes too great, the coating begins to acquire a matte finish and reflectivity declines.

If you are experimenting to try to find the optimum aluminum thickness for your application, you might want to fixture up a piece of clear glass or plastic in the chamber. When you have sufficient coverage for opacity, you will be close to the point of maximum reflectivity. Depositing more aluminum than this will not produce gains in reflectivity and may well decrease filament life.

Q: The aluminum coating is thin enough to see through on some areas of my part. Other areas are fully opaque. What's happening?

A: It is likely this is a fixturing problem. Check to see if an obstruction passes between the lightly coated area and the filaments during the evaporation. The obstruction can be another area of the part which protrudes out, other parts which are fixtured nearby, or the filament standoff posts. Sometimes parts toward either end of the chamber are poorly coated on the side that faces the chamber wall since there are no filaments there.

Q: I'm coating the inside of a box. The bottom has a more opaque coating than the sides. Why?

A: This is a problem that becomes more pronounced as the depth of the box exceeds the width of its opening. Vaporized aluminum radiates from the filaments in a straight line. The bottom of the box "sees" more aluminum than the sides do. Imagine shining a light into the box from several feet away. The bottom of the box will be lit better than the sides. The principle is similar. Since there are many filaments and the box is rotating, it is possible, with careful fixturing, to allow the sides to "see" the filaments, too. If the problem persists after refixturing, try adding filaments to the chamber.

Q: I get good coverage with aluminum but when I try to evaporate copper, silver, or other metals, the coverage is poor. What is wrong?

A: Aluminum is an easy metal to evaporate. It has a relatively low density and temperature at vapor pressure compared to other metals. Since a metal like copper, silver, or gold is more dense and has to be brought to a higher firing temperature, it is more likely to run down and drip off the filaments before it is all fired off. We usually recommend increasing the number of filaments to achieve better coverage in this situation. You mad need to add as many as 50% more filaments to get good coverage. Make sure you have enough power available to run them all.

Q: Why do the parts at the back of my chamber have poorer coverage?

A: Check for backstreaming from your pumps. This could be interfering with proper deposition of evaporant. Other telltale signs include darkening of these parts, poor adhesion on these parts, or a loss of volume of pump fluids over time. Also, see the first question on this page.

Q: What thickness gives the best coating?

A: That must be determined by you and your customer. Are you trying to achieve maximum opacity or reflectivity? Are you doing EMI or RFI shielding work? The information presented here can help you make that determination. For more information on coatings for EMI/RFI shielding, see our tips entitled RFI Coating.

For more information of aluminum evaporants or to discuss your application, call us.

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