Beryllium X-ray Window Coatings / Transmittance Curves

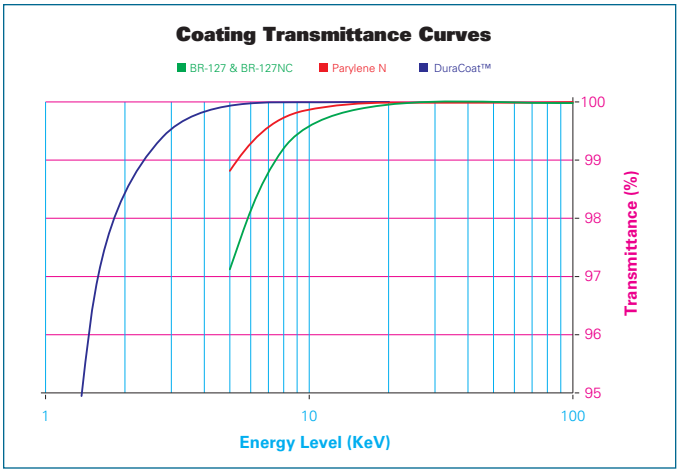
Beryllium windows are an excellent means of isolating vacuum and/or other environments from air while allowing X-rays to pass through unrestricted. When used with inert or totally dry environments, beryllium windows can last almost indefinitely. In fact, actively cooled beryllium windows installed at synchrotron facilities, where neither side is exposed to atmosphere, have been in continuous service for over 10 years. However, if windows are used in less controlled environments, corrosion can occur quickly. Exposure to moisture (such as atmospheric humidity) or chlorides and sulfates (found in non-deionized water), could lead to corrosion in a matter of hours. This corrosion may eventually result in a system vacuum leak.

Various anticorrosion coatings are available to protect thin beryllium windows. The most common coatings used for X-ray applications are BR-127, BR-127NC, Parylene N, and DuraCoat™ (sold by Moxtek). Metal coatings, such as electroless nickel, aluminum and gold, are effective corrosion barriers, but may also inhibit X-ray transmittance. Other coatings, such as BerylCoat-D, have only minor impact on X-ray transmittance, but lack the durability under typical operating requirements. There are three main points to consider when choosing protective coatings for beryllium X-ray windows:

- Impact on X-ray transmittance
- Processing and operating temperatures
- Cost and lead-time.

As depicted in the transmittance graph at right, all coatings have about the same effect on X-ray transmittance in the 7keV or higher energy range (beryllium's useful energy range). However, close attention should also be given to the elements that comprise a coating. For example, Parylene N is a polymer consisting of only carbon and hydrogen, while DuraCoat™ is made entirely from elements lighter than carbon and BR-127 contains traces of heavier elements such as iron, chromium, and strontium, which do not have a serious impact on X-ray transmittance, but could influence readings when analyzing for these specific elements. BR-127NC is essentially the same as BR-127, but without the chromium. That results in a coating with slightly less corrosion resistance than BR-127, but without the chromium to affect the data, either.

High temperature bakeouts, subsequent joining processes, and operating temperatures are also important factors affecting coatings. Parylene N is suitable to 125ºC (260ºF), BR-127 and BR-127NC primer to 150ºC (300ºF)



and DuraCoat™ can be used continuously in atmosphere at temperatures up to 500ºC (930ºF).

One should also consider how using any specific coating will impact budgets and schedules. BW-Electrofusion offers BR-127 and BR-127NC epoxy primers as in-house processed coatings and available at a relatively low cost, with minimal impact on delivery. Parylene N coatings are relatively inexpensive, but require an additional two weeks of lead time. The DuraCoat™ coating process, which offers good X-ray transmittance and the highest available temperature endurance, is offered at a premium price commensurate with its superior performance level, and will also add two weeks to our standard delivery.

Health & Safety Note:

Handling solid beryllium material poses no significant health risks. However, as with many other industrial materials—materials containing beryllium may pose a health risk, if and when recommended safe handling practices are not followed and adhered to. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) have set mandatory limits on occupational respiratory exposures. Read and follow the guidance set forth in the Material Safety Data Sheet (MSDS) before working with beryllium. For additional information on safe handling practices or technical data on beryllium, contact Brush Wellman Electrofusion Products.

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