

X-1 Silver: A High Durability Silver Coating for use in Harsh Environments

Ian C. Stevenson & George Sadkhin
Denton Vacuum, LLC, Moorestown, NJ

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ABSTRACT

Silver reflective coatings are attractive in optical systems because of their intrinsic high reflectance over a broad spectral range. Their use has been limited due to their tendency to tarnish when exposed to harsh operating environments. Denton has developed a silver coating with greatly increased durability as measured by its resistance to attack by salt fog and other standard environmental tests.

INTRODUCTION

For more than two decades Denton Vacuum's front surface silver coating, FSS99, has enjoyed a well deserved reputation as one of the most dependable coating options for many applications: space flight, telescope mirrors and ground based systems. Indeed, because of its broad, high reflectance and typically excellent lifetime, FSS99 is often called out on mirror drawings as the coating of choice.

In recent years, our customers have become more demanding in a number of ways. High reflectance mirror coatings are now required on a variety of substrate materials. Even better optical performance is often expected, and of course the lifetime of silver coatings is always an issue as they must sometimes be exposed to less than desirable conditions during system assembly, even when the ultimate conditions of use may be quite benign.

To deal with these demands, Denton's FSS99 silver has evolved into a flexible family of coatings, each one tailored to meet specific needs. Under normal conditions, all of these varieties of FSS99 exhibit good durability in that they pass the standard requirements of MIL-M-13508C. However, they can deteriorate when exposed to harsh environments such as smog and when FSS99 coatings are subjected to the 24 hour Salt Fog test they typically show some deterioration. (Figure 1)

Denton has an ongoing development program to investigate ways in which the durability of our silver coatings might be improved without sacrificing their excellent optical performance. Process enhancements

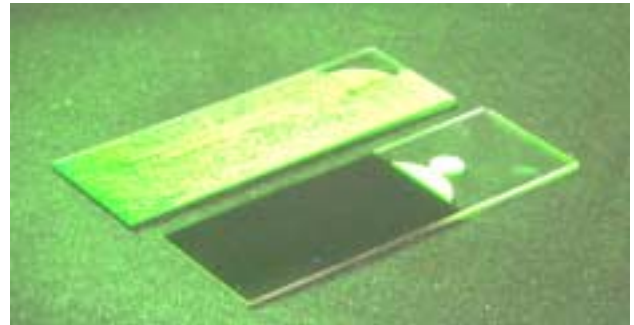


Figure1: X-1 Silver (foreground) and FSS99 (background) after 24 hour exposure to Salt Fog

such as ion beam assisted deposition (IBAD), substrate heat and alternative material structures are being investigated, the aim being to develop a coating that survives the salt fog test and retains the high, broadband reflectance typical of FSS99. The latest product to emerge from this effort is X-1 Silver, a high durability, high reflectance coating for use in harsh environments. The protective layers have been changed and the process modified to give much better protection for the silver layer. X-1 Silver consistently survives the Salt Fog test with no visible deterioration and no measurable loss of reflectance. (Figure 1)

Because the protective layers are all non-absorbing, spectral performance shows good agreement with theory and is similar to FSS99 reflectance. (Figure 2)

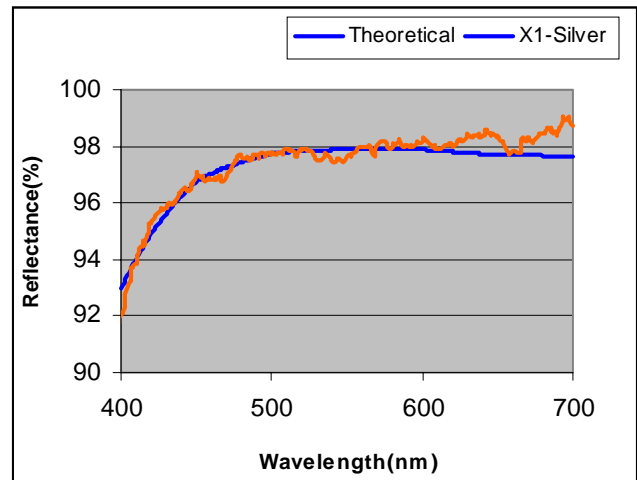


Figure2: Measured & theoretical reflectance of X-1 Silver