Degradation of Avian-B and Avian-D White Reflectance Coatings

Avian-B and Avian-D white reflectance coatings have been the industry standard for over two decades. They provide high diffuse reflectance over the range of 250-1700 nm (Avian-B) and 300-1300 nm (Avian-D) for a wide range of applications, typically being the coating of integrating spheres and cavities for a wide range of applications.

Over the years of coating spheres, Avian Technologies has seen few cases of degradation of the coating, which usually manifests itself as yellowing over a period of a few months. These cases are rare- typically on an average of a couple per year- and localized to a single plant or application. In every case, the problem of the degradation is environmental. This degradation can be explained by one of four mechanisms. These are outlined in reverse order of likelihood.

1) Over-expose to laser light. This is typically seen when the coatings are used for reflectors in pumped laser cavities. This is an application we do not recommend, but have customers use the coating material for this application anyway. If the coatings are exposed to pumped light that is in excess of 2 Wcm^2, the coating tends to yellow (and then blacken), typically starting at the back of the coating, progressing up to the surface.
   We have some customers using Avian-B in pumped laser cavities with success, but we do not recommend either of these coatings for pumped laser cavities.

2) Overheating of the coating. We do not recommend using these coatings when the temperature will exceed 110°C for anything other than a short period of time. As with laser cavities, the coating tends to yellow, typically starting at the back of the coating, progressing up to the surface. This is a rare occurrence- since we have been applying coating at Avian Technologies, we have not seen a single case of yellowing due to overheating.

3) Contaminants are introduced into the sphere from the measurement port. If one is measuring particulates or loose materials, it is not uncommon for some of the material being measured to fall into the sphere. In this case, the contamination is limited to a fairly small area and may, in some cases, be ‘fixed’ by blowing out the sphere with compressed air. We have seen contamination of spheres by snack foods, cigarette ashes, lint, and many other ‘unusual’ contaminants.

4) **Exposure to air-borne contaminants, including air pollution and cigarette smoke.** This is by far the most common cause of yellowing and is, in fact, the only one we have experienced in 15 years of applying our coatings.

White reflectance coatings consist of a finely divided white pigment, held together by a very small amount of binder. This finely divided substrate acts in much the same way as a chromatography column. It adsorbs contaminants from the air and physically binds them to the coating surface. Over time, these contaminants build up and oxidize to form a yellowish surface layer (unlike the two reasons above), where the yellowing starts at the sphere/coating interface). When one opens the sphere, the smell of the contaminant can easily be detected if it is from smoke. It may be harder to detect if it is another air-borne contaminant. In all cases, the best way to prevent yellowing of the sphere coating is to not expose the spheres to contamination, be it solid, liquid, or air-borne.