Comparison Between Existing PTFE Optical Reflectance Material and Potential Alternatives

Background

Optical reflectance materials are used in a variety of industries including aerospace, automotive, medical, consumer electronics, military & defense, Lighting, Image Sensors, Industrial Photonics, Cosmetics, Life Sciences, Sun Protection, and Telecommunications. The range of PTFE used in these industries varies from components to test equipment that is used to characterize the performance and determine pass/fail criteria against industry standards. These applications would fall in a new sub-category of "PFAS in Optical Applications."

Performance Comparison: Reflectance

The PTFE used in these applications can come in solid form as an optical reflectance standard, or as part of a spray coating that is bonded to a surface. In most cases, a high reflectance is required that has uniform, diffuse reflectance properties. If these criteria are not achieved, many of the standard industry tests cannot be realized, and the resulting uncertainty in the measurements requiring these materials will be invalid. As a comparison, the top contender for a replacement to an optical PTFE reflectance material is ceramic. The plot below compares the reflectance of optical PTFE, Ceramic, and Spray coating with PTFE material embedded in the formulation.

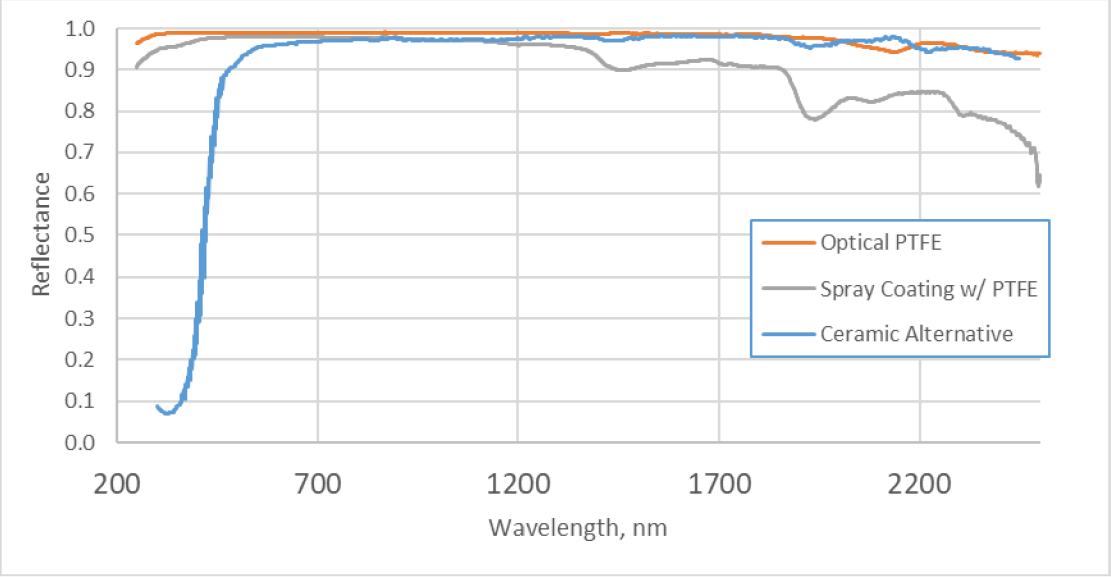
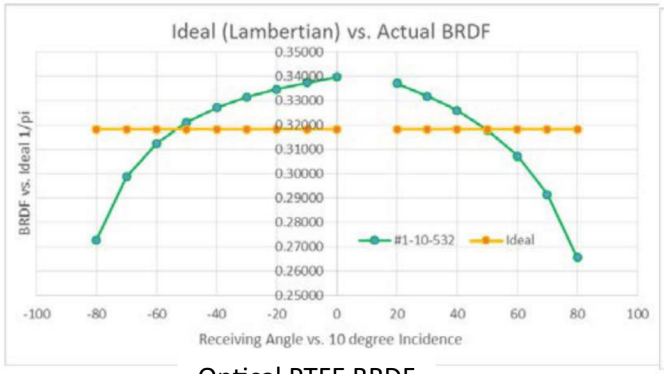


Figure 1 Comparison in optical reflectance between optical PTFE, Spray coating with PTFE, and Ceramic Alternative.

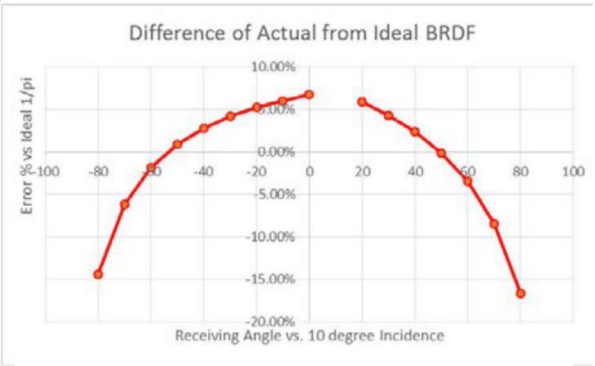
As seen in the plots, the reflectance at wavelengths below 700 nm is severely reduced. This is the visible range of the human eye (380 – 760 nm) which affects the majority of the applications. Since the difference is extreme in this region, there is no practical way to overcome this deficiency with this alternative ceramic material.

Report Submitted By Labsphere, Inc. Contact: Dan Scharpf, [redacted]@labbsphere.com

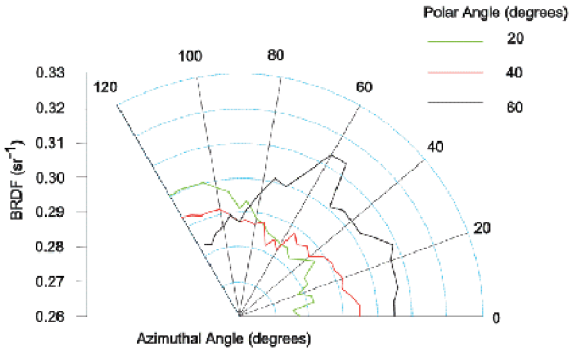
Other materials may have higher reflectance, but the ability to reflect light diffusely is limited. This optical property is critical for many applications where scattering light evenly is required and is represented by the BRDF value (Bidirectional Reflectance Distribution Function). Current optical PTFE material varies from the ideal Lambertian scattering by ±5% over reflectance angles of ±60°. By comparison, ceramic is in error > 30% in the same range.



Optical PTFE BRDF



Optical PTFE BRDF Deviation from Ideal, %



Ceramic BRDF

Figure 2 Comparison between Bidirectional Reflectance Distribution Factor for Optical PTFE, and Ceramic Alternative. Ideal Lambertian reflectance would follow a cosine response across all reflectance angles.