Ocean Optics

# Application Note

### Keywords

- Encoder wheels
- Zinc
- Plastics

### Techniques

- Specular reflection
- Diffuse reflection

### Applications

- Materials evaluation
- Reflectance measurements

# Effect of Sandblasting on the Specular Reflection from Encoder Wheels

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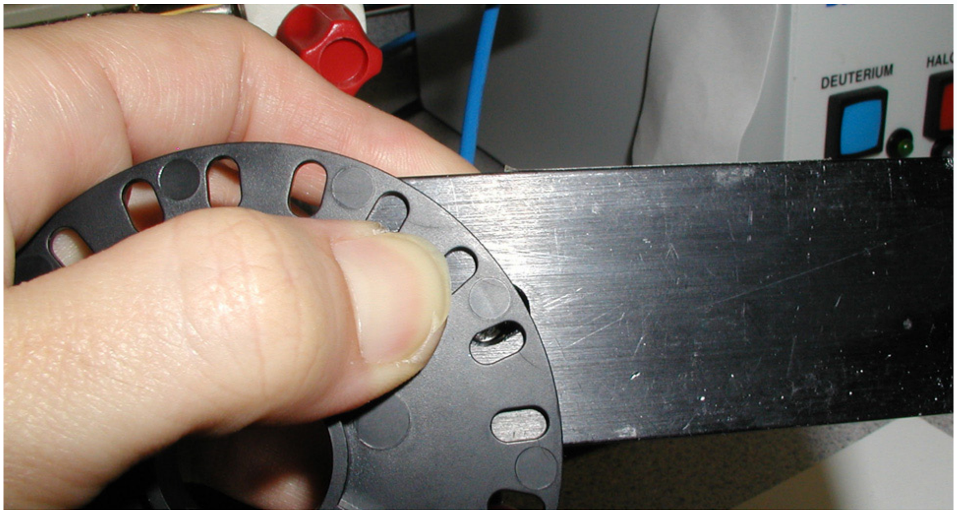
Spectral reflectance measurements can compare objects of different colors and textures. Also, reflectance can reveal information about the material from which a sample is made, since light that is not reflected from a sample either is absorbed due to its chemical composition, or scattered or transmitted.

In this application note, conducted as part of a feasibility study, we measured the reflectivity of both metal and plastic encoder wheels before and after sandblasting. Sandblasting is often part of the process of preparing machined parts, and in this case may have been used to lessen the specular reflection of the metal and plastic materials.

## Background

Encoder wheels are electro-mechanical components that are used in motors and other devices monitoring rotation, speed and the like. Often, the wheels comprise glass, metal or plastics and have applications in a range of industries.

For encoder wheel producers, the ability to evaluate raw materials and to monitor quality parameters at-line, in real time, could result in improved processing, higher quality finished goods and less waste.




## Experimental Conditions

Both zinc and plastic encoders wheels were analyzed, some of which were sandblasted across 50% of the surface of the wheel. The plastic wheels were made of ABS (acrylonitrile butadiene styrene) or POM (polyoxymethylene), which are robust materials used in products ranging from automotive parts to piping systems.

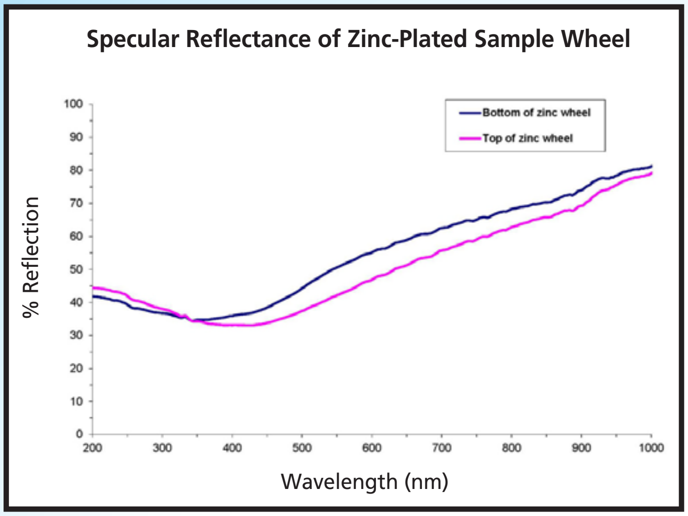



Figure 1: Zinc samples showed comparable reflectivity from both sides of the sample wheel.

Using an HR-series high-resolution spectrometer (200-1050 nm), balanced deuterium-tungsten halogen light source, 400 µm reflection probe and probe holder, we measured specular reflectance at 90 degrees relative to the sample surface for each sample on both the top and bottom sides of the sample. Also, for some of the samples we measured diffuse reflectance, with the probe at 45 degrees relative to the sample surface. In addition, we used various sampling methods to account for different sample shapes.

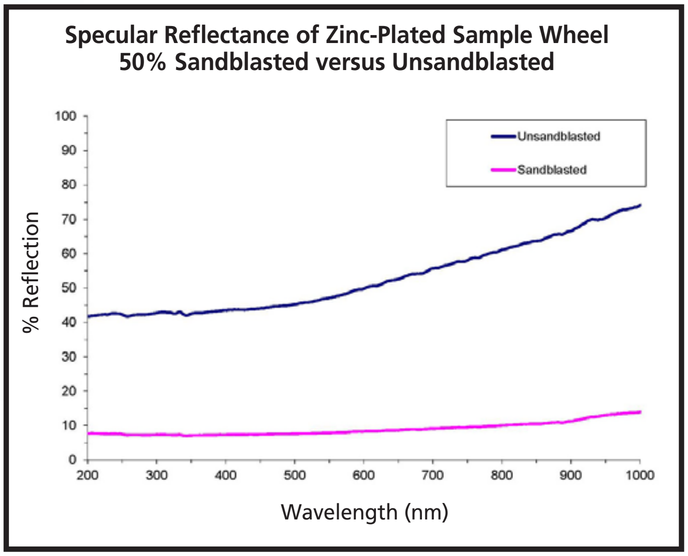



Figure 2: With all sample materials, sandblasting resulted in lower specular reflectance.

The smooth, glossy zinc-plated encoder wheels were analyzed using a high reflectivity specular reflectance standard (~87%-93% reflective from 200-1100 nm) as the reference. The first zinc-coated sample showed comparable reflectivity from both sides of the wheel (Figure 1). Conversely, the sandblasted zinc-coated wheel had much lower reflectance than the untreated zinc-coated wheel (Figure 2).

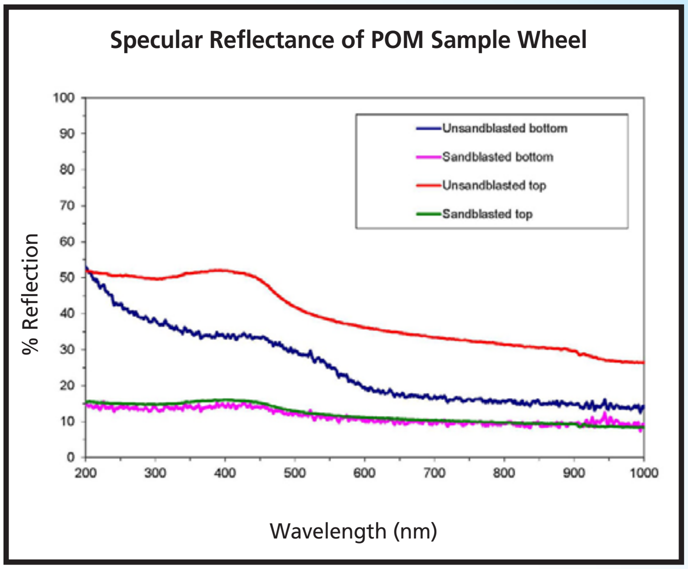



Figure 3: Sandblasting affected the reflectivity of plastic wheel samples, although not as dramatically as with the zinc wheels.

For the plastic encoder wheel samples, specular reflectance measurements also varied when sand-blasting was applied (Figure 3). Similarly, diffuse reflectance measurements of the plastic wheels varied according to surface treatment and had much lower overall reflectivity than the zinc wheels.

## Results

For specular reflectance measurements, sample reflectance always decreased following sandblasting. To provide a more quantitative assessment of the decrease, the specular reflectance at 400 nm (wavelength chosen arbitrarily) was compared for a series of sandblasted and untreated samples.

The results in Table 1 show the percent reflectance values at 400 nm for 3-5 replicate measurements at different locations on each sample. The biggest difference in specular reflection for sandblasted versus untreated samples (~84% difference) was observed for the zinc wheels, which also showed variability in reflectance by sampling location. Sandblasting also affected the reflectivity of the plastic samples, although not as dramatically (69% difference) as with the zinc samples.

## Table 1: Difference in Reflectivity for Various Zinc and Plastic Encoder Wheels

| Sample Type | % Reflectivity without Sandblasting | % Reflectivity with Sandblasting | % Difference |
|---|---|---|---|
| Zinc | | | |
| Bottom | 66.53 | NA | 8.51 (bottom versus top) |
| Top | 60.87 | NA | NA |
| Zinc (w/ unsandblasted zinc as reference) | NA | 16.78 | NA |
| 50% Sandblasted Zinc | 53.55 | 9.73 | 83.65 |
| ABS Plastic | | | |
| Bottom | 29.85 | 10.93 | 63.38 |
| Top | 31.91 | 9.85 | 69.14 |
| POM Plastic | | | |
| Bottom | 15.57 | 9.16 | 41.15 |
| Top | 32.02 | 9.87 | 69.17 |
| POM Plastic (w/ unsandblasted POM as reference) | NA | 45.41 | NA |

An additional set of measurements was done with the probe placed in the 45 degree position in the reflection probe holder for the 50% sandblasted zinc-plated wheels and ABS or POM encoder wheel samples (Figure 4). A diffuse reflectance standard was used as a reference for these measurements. In contrast to the specular reflection measurements at 90 degrees, the diffuse reflectance increased after sandblasting. (Presumably, the sandblasting made the sample surfaces rougher and less glossy.) This was also true for diffuse reflectance measurements of the 50% sandblasted zinc-plated encoder wheel, with even greater differences between sandblasted and untreated samples.

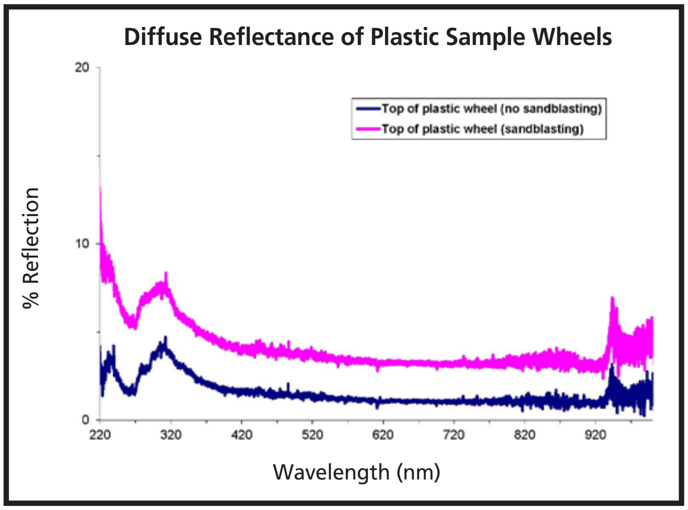



Figure 4: As expected, diffuse reflectance in both zinc and plastic wheels increased after sandblasting, presumably because the treated sample surfaces were rougher.

## Conclusions

The availability of modular spectroscopy components such as our HR series spectrometers, light sources and accessories allows users to evaluate materials such as metals and plastics for reflectance and other spectral characteristics without having to dramatically change setups or move to another instrument station. In industrial settings, modular spectroscopy systems are easily integrated into process streams to optimize measurements.

As our reflection measurements indicated, both diffuse and specular measurements are easily achieved using similar components, with adjustments in sampling position and experiment parameters simple to manage via both hardware and software.

**Contact us today for more information on setting up your spectroscopy system from Ocean Optics.**

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