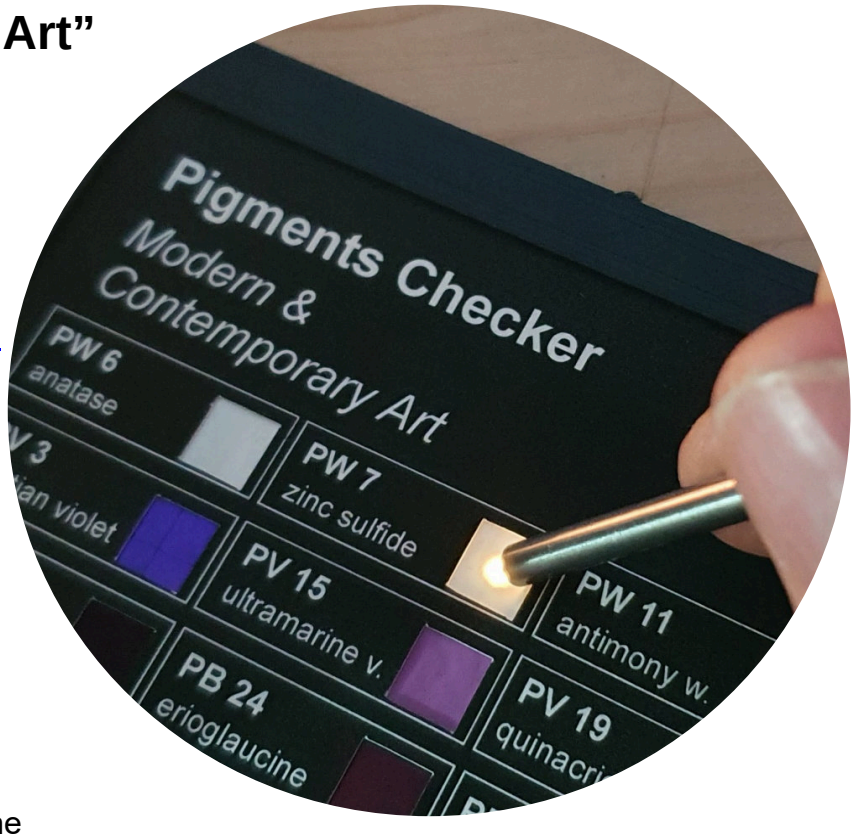
CHSOS Application note # 4
April 2022

Author
Antonino Cosentino (CHSOS Director)

Reflectance Spectra Database (Gorgias Spectrometer) for Pigments Checker "Modern & Contemporary Art"



Just published on our website the Reflectance Spectra Database for the new Pigments Checker "Modern & Contemporary Art".

This paper discusses some of these spectra and highlights the most important findings.

Used from the late 80' [1] Reflectance Spectroscopy (RS) is a powerful tool for the identification of pigments and dyes [2]. A reflectance spectrum shows for each wavelength the ratio between the intensity of the reflected and incident radiation. This ratio is called reflectance and is given in percentage (%). Pigments are identified using a spectral database and comparing the spectral features of the investigated unknown spectrum with the spectra available in the database.
The advantages of this method with respect to the other spectroscopic methods are: affordable equipment, small dimension, and portability.

Pigments Checker "Modern & Contemporary Art"

This is a collection of the most important pigments used in modern & contemporary art. On the other hand, the STANDARD Pigments Checker is a collection of the most used pigments from prehistory to contemporary art, and consequently, it has just few modern pigments. This new checker is focused solely on modern pigments and completes those already included in the standard Pigments Checker. The colors are laid with an acrylic binder on a cardboard

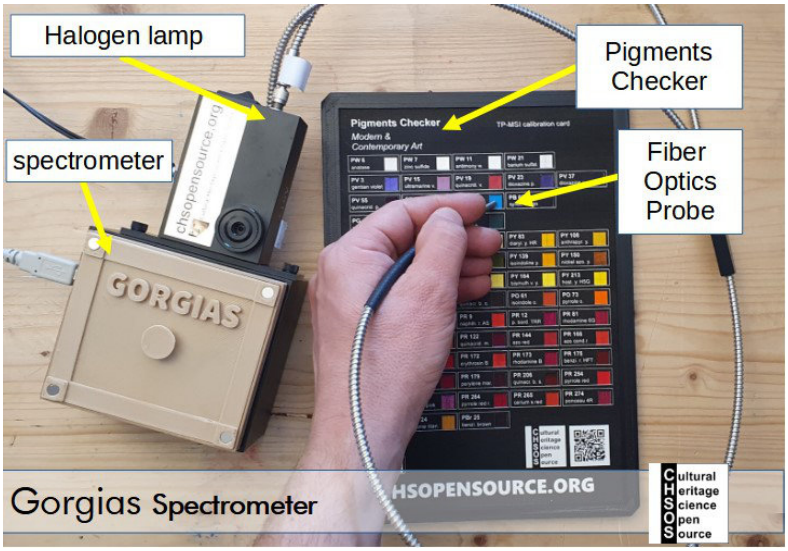


Figure 1. Gorgias Spectrometer testing on Pigments Checker "Modern & Contemporary Art".

support. We collected the spectra of the pigments and that of the binder alone on the cardboard. All these spectra are available online on the Pigments Checker webpage.

Pigments with noticeable characterizing features

Figure [1] shows the Gorgias system acquiring spectra on the new Pigments Checker.

Some pigments feature unique and characterizing features. The spectra of 4 modern pigments are reported in Figure [2].

PBr 24 - chrome titanate, available from 1946, has a strong and large absorption band centered at 730 nm.

PG 36 - phthalo green YS, has great lightfastness and it is always used with extenders and fillers to make it more workable. It is a bromated and chlorinated copper phthalocyanine that features a characterizing maximum close to the UV region at 410 nm.

PY 53 - nickel titanium yellow, is a nickel antimony titanium rutile pigment, used as a replacement for the historical naples yellow. It features a large and strong absorption band centered at 740 nm.

PY 150 - nickel azo yellow, a monoazo nickel complex, is used as a replacement for the original indian yellow, since it has the same brownish tint. It is identified by its unique 3 maxima at 600 nm, 650 nm and 715 nm.

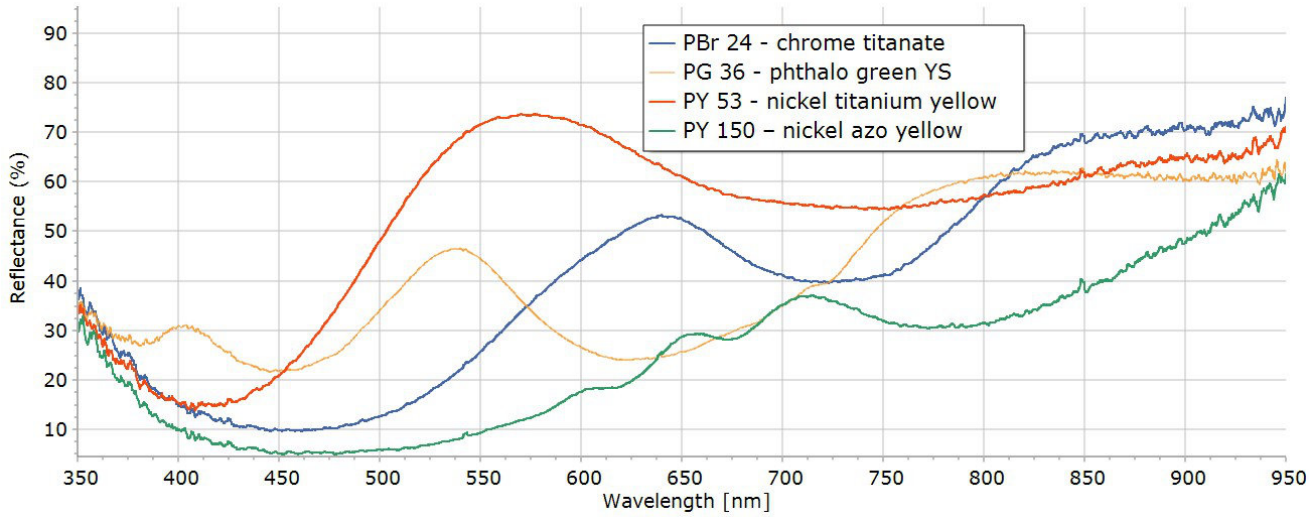


Figure 2. Noticeable spectra acquired with Gorgias spectrometer on Pigments Checker "Modern & Contemporary Art".

Titanium white, rutile or anatase?

Titanium white is a general name to indicate a white pigment that is made of one (or a mixture) of the two forms of titanium oxide: anatase and rutile. These crystals have the same chemical formula, TiO_2, but different relative positioning of the 3 atoms (they are 2 polymorphs of titanium oxide).

The standard Pigments Checker v.5 has the rutile titanium white. Nowadays titanium white is all made from rutile. But this was not always the case. From about 1920 titanium white was made mostly of anatase because it was more easy to produce. From about 1940 a cheap production method for rutile was established and it replaced anatase, since it was more lightfast and had a stronger hiding power.

The new “modern and contemporary art” pigments checker has the “anatase” titanium white.

Figure [3] shows the reflectance spectra of the two types on titanium white, anatase and rutile, acquired on the two pigments checkers, “standard” and “modern & contemporary art”. The two type of titanium white can be distinguished by their reflectance spectra since the absorption band in the UV has the inflection point at 405 nm for rutile and 380 nm for anatase.

We did test the Gorgias spectrometer on a Indian Mughal manuscript which was supposed to be from the 18th century, likely 1790, figure [4].
We were interested in evaluating the authenticity of the item and, in particular, its dating.

As shown in figure [3] the spectrum of the white paint (point 4) is comparable to the spectrum of anatase. This type of titanium white was also confirmed with the Raman Spectroscopy system ElviRA.

We know that anatase was in use from roughly 1920’-1940’. For a manuscript supposedly made in the 18th century, we were expecting lead white pigment,

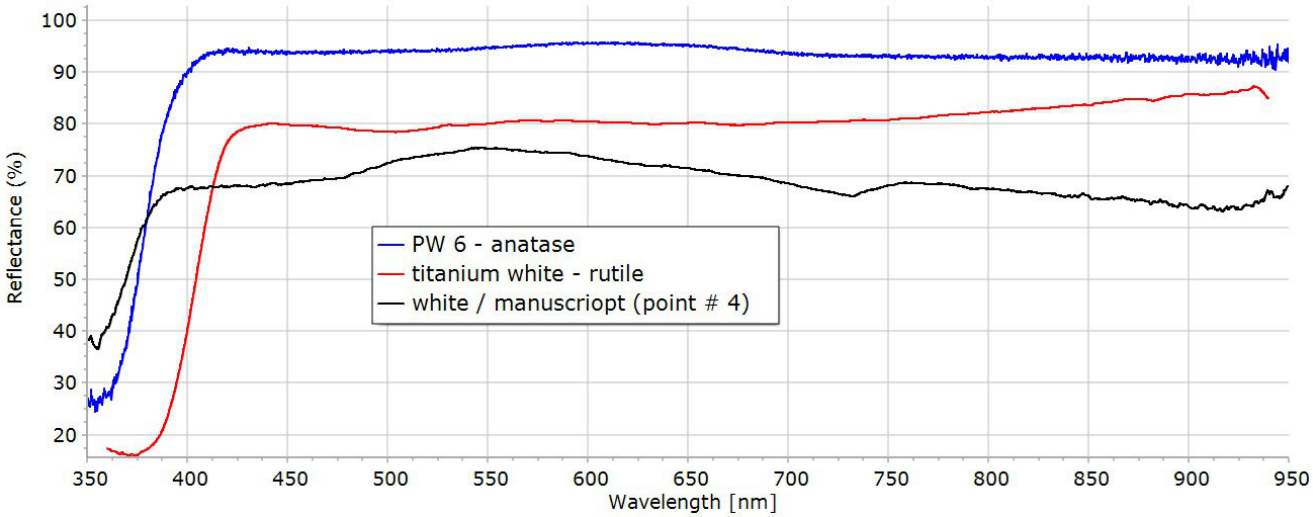


Figure 3. Reflectance spectra of the two types of titanium white, anatase and rutile, and of the white paint on a Indian Mughal manuscript.

Figure 4. The Gorgias spectrometer testing the authenticity of an Indian Mughal manuscript.

definitely not anatase. Furthermore, the identification of anatase indicates that the object was created not much later that the 1940', otherwise we should have found more of the rutile titanium white.

Red and yellow pigments

The red pigments, figure [5], feature the usual spectrum for the red color. They absorb the blue and the green spectrum and reflect light starting from the yellow region, from about 600 nm. Though, they can be distinguished by the position of their respective inflection points.

Same can be said for the yellow pigments, as shown in figure [6].

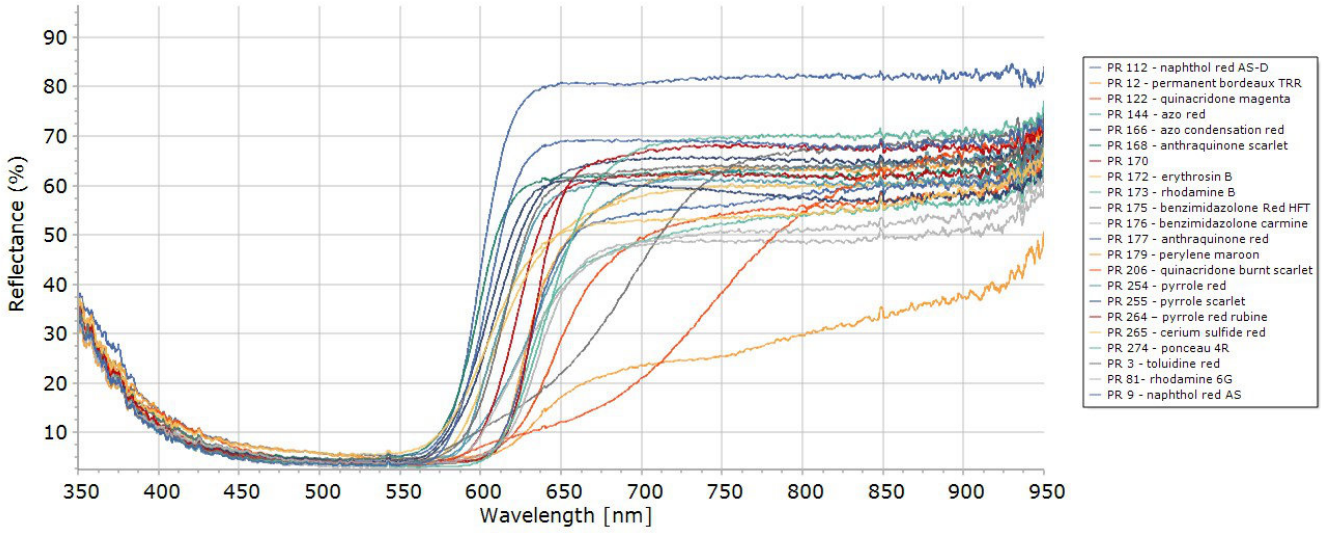


Figure 5. Reflectance spectra of the red pigments in Pigments Checker "Modern & contemporary Art".

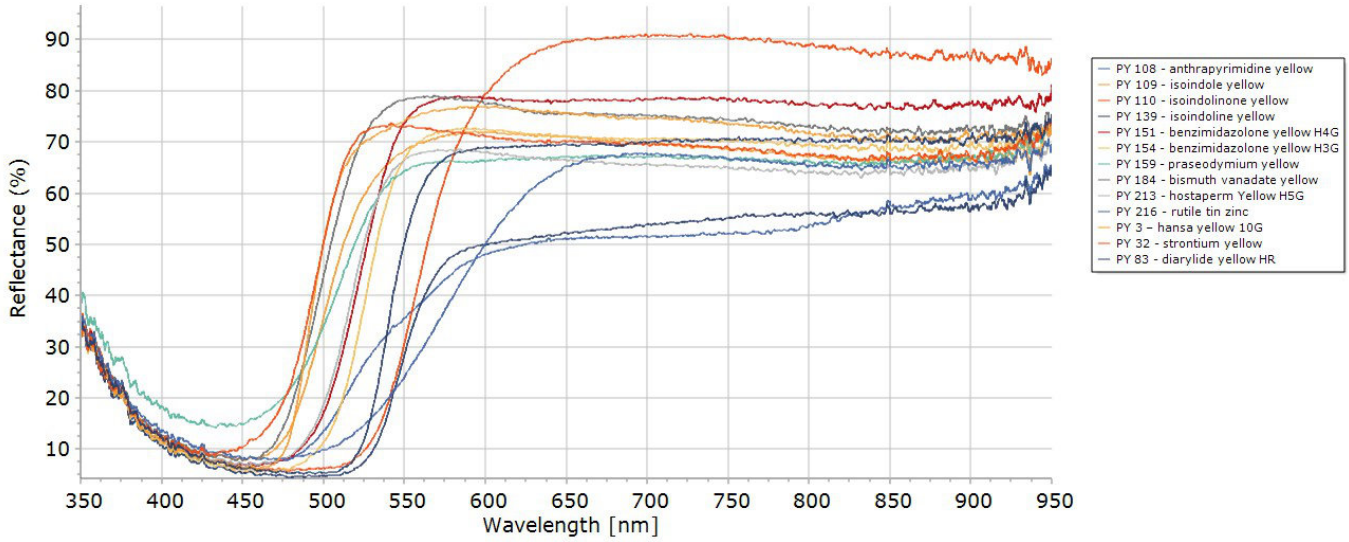


Figure 6. Reflectance spectra of the yellow pigments in Pigments Checker “Modern & contemporary Art”.

White Pigments

The new pigments checker has 4 whites. We discussed already PW 6 - anatase. PW 7- zinc white is remarkable for the strong absorbance bands in the red-infrared region 650 - 750 nm. This material is not used alone as a paint but it is found with other pigments to provide them with hiding power, such as for lithopone. This last one is a mixture of barium sulfate and zinc sulfide. PW 11- antimony white, used as an artist pigment from 1920, its characterized by its flat curve that makes it a very “real” white. Figure [8] illustrates the case of lithopone, we just introduced at the beginning of this paragraph while discussing the peculiar absorption bands of the zinc sulfide. Lithopone is a mixture of barium sulfate which has a pretty featureless spectrum and zinc sulfide. The resulting spectrum of lithopone shows the zinc sulfide features, since barium sulfate is pretty flat.

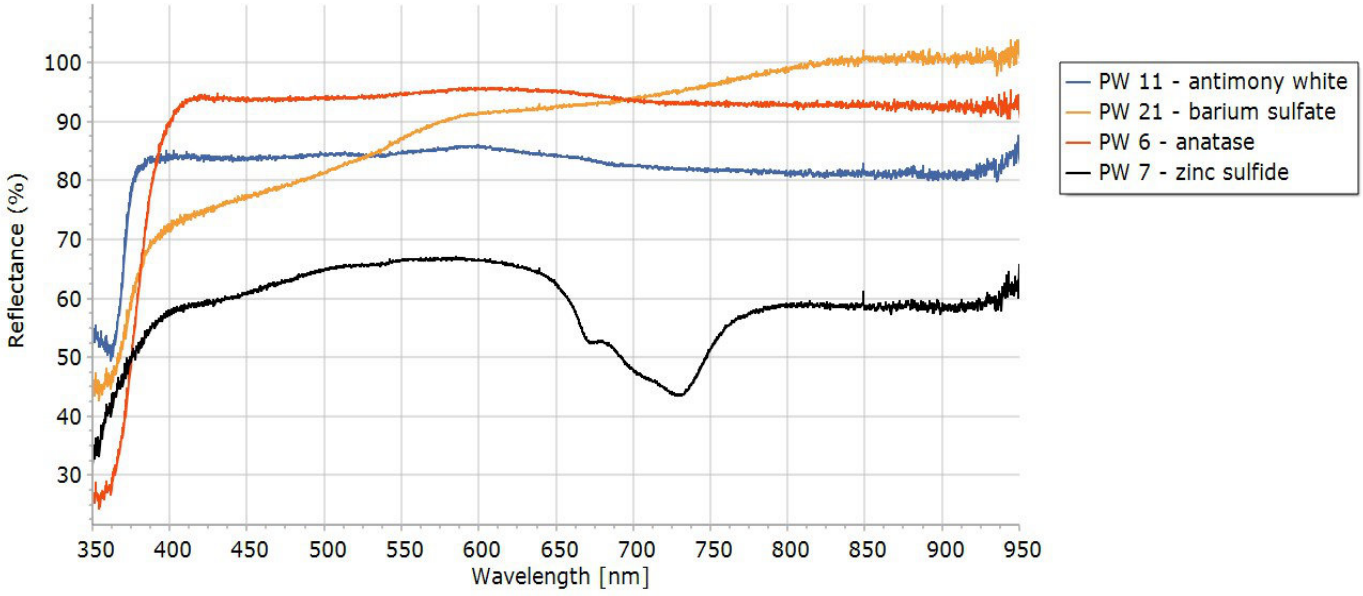


Figure 7. Reflectance spectra of the white pigments in Pigments Checker “Modern & contemporary Art”.

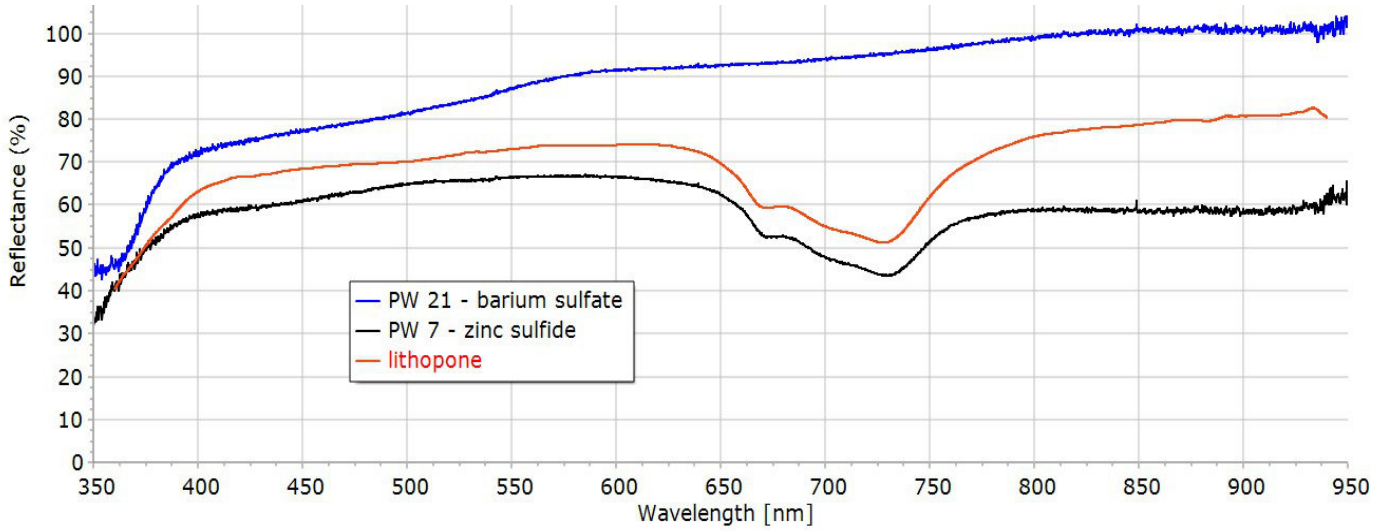


Figure 8. Reflectance spectra of the mixture pigment lithopone, and of its components, barium sulfate and zinc sulfide.

Conclusions

Gorgias is a portable and a low-cost reflectance spectroscopy system. We suggest to use Gorgias for most applications and in particular for those that require mobility and travel with the equipment. The analysis of the new set of modern pigments confirm that even with these modern paints, reflectance spectroscopy is a valid tool for, at least, a preliminary characterization of the colors.

References

[1] BACCI, M., CAPPELLINI, V., CARLA', R. (1987). Diffuse reflectance spectroscopy: An application to the analysis of art works, Journal of Photochemistry and Photobiology B: Biology, 1, Issue 1, 132.

[2] FONSECA, B., SCHMIDT PATTERSON, C., GANIO, M., MACLENNAN, D., & TRENTELMAN, K. (2019). Seeing red: towards an improved protocol for the identification of madder- and cochineal-based pigments by fiber optics reflectance spectroscopy (FORS). Heritage Science.

Newsletter

Cultural Heritage Science Open Source

Join our mailing list

Get our updates, special offers, used equipement, discounts, and much more

Gorgias – Reflectance spectrometer for Art

3.754,00€

Add to cart

Pigments Checker (TP-MSI calibration card included)

670,00€ – 730,00€

Select options