HARRICK SCIENTIFIC PRODUCTS

No. 70522

MERIDIAN™: A ROCK-SOLID ATR

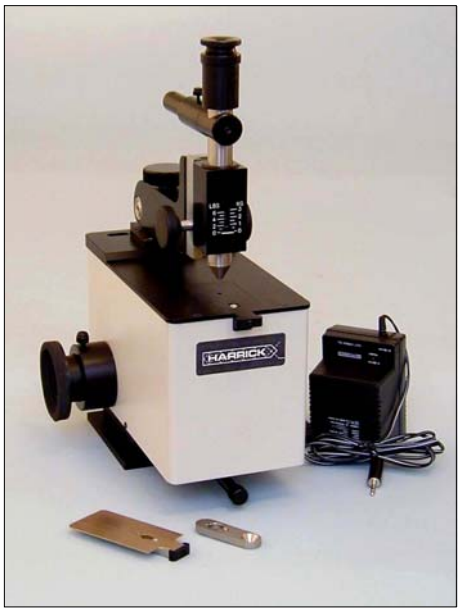

Figure 1. The Meridian™ Diamond SplitPea™, shown with its ViewThruPress™.

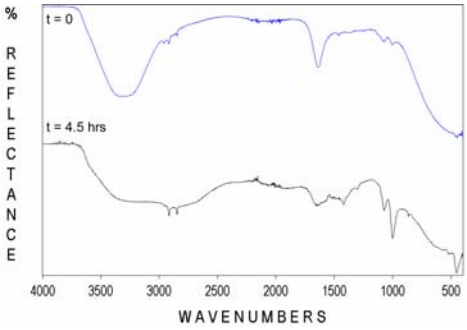

Figure 2. ATR Spectra of Easy Off Oven Cleaner.

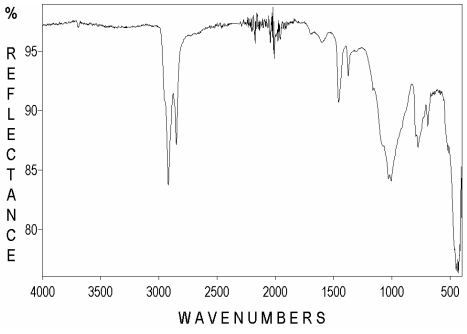

Figure 3. ATR Spectrum of Asphalt Sealant.

INTRODUCTION

The Meridian™ is an exciting new development in the field of ATR[1] microsampling. It combines the extremely small sampling area of the SplitPea™ with an incredibly durable and chemically inert diamond ATR crystal. This creates an ATR accessory that can sample virtually anything.

Harrick's SplitPea™ revolutionized spectroscopic analysis by introducing a practical method for internal reflection (ATR) micro- and nano-sampling in the early 1990s. ATR microsampling is now used worldwide to analyze a wide variety of samples in quality control, research, and development environments.

For ATR nano-sampling, a sample is placed on a micro-ATR crystal. This ATR crystal is generally made from a hard material, so that a significant amount of pressure can be applied to compress solid samples and powders against the sampling area of the crystal. Since the sampling area is extremely small, good contact can be obtained with hard samples that generally could not be examined by other ATR methods.

The ATR accessory generally has a built-in beam condenser to direct the beam into the crystal, and crystal is frequently shaped like a hemisphere to further condense the beam. The original ATR nano-sampler used a high refractive index crystal material to insure the smallest spot size possible to permit analysis of extremely small samples with minimal stray light effects.

However, the high refractive index infrared materials, like Ge and Si, are not the strongest and most inert. Diamond exceeds both these materials in these characteristics and has a higher coefficient of friction, making it exceptionally easy to clean. Due to its absorption bands, diamond is not normally considered a good infrared optical material. However, since the pathlength through the crystal is so short in these micro- and nano-ATR accessories, diamond becomes an excellent choice.

The Meridian™ is a new, rock-solid diamond ATR nano-sampler. It features a solid 3-mm diameter diamond ATR crystal, giving an effective sampling area 500 □m in diameter. This is the smallest sampling area of any diamond ATR in-compartment accessory available today.

To demonstrate the versatility and power of the Meridian™, several types of samples have been examined and the results are presented herein.

RESULTS AND DISCUSSION

The primary advantages of using the diamond ATR crystal include its high chemical inertness and high strength.

applications note

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These permit analysis of a variety of samples, as demonstrated in Figures 2 through 6. All spectra were recorded with a Nicolet Nexus set for 32 scans and 4 cm^{-1} resolution in a purged environment. The Meridian™ installed in the Nexus was also purged using Harrick's patented PermaPurge™ technology.

Figure 2 shows the ATR spectra of Easy Off®[2], a highly corrosive oven cleaner whose active ingredient is NaOH. A drop of the oven cleaner was placed in the center of the crystal and allowed to sit for several hours. The spectra clearly show water evaporating from the oven cleaner and concentrating the remaining ingredients. The highly corrosive nature of this sample would have damaged most other ATR crystals. Note that these spectra could also have been measured using the Meridian's liquid cell to help contain the sample.

In addition to corrosive liquids, the Meridian™ can be used to examine hard, irregularly shaped solids. This is demonstrated in Figure 3, where the spectrum of dried Asphalt Roof Cement and Sealant[3] is shown. In this spectrum note the increased noise level between 2300 cm^{-1} and 1850 cm^{-1}. This is due to the incomplete subtraction of the strongly absorbing diamond bands. This spectral interference from diamond is minor, since very few materials have absorption bands in this region.

Figures 4 through 5 show the Meridian's ability to collect spectra from extremely hard solids. Figure 4 shows the spectra from three different kinds of rock. These rocks are composed primarily of lazurite ($3Na_2O_3{\cdot}3Al_2O_3{\cdot}6SiO_2{\cdot}Na_2S$), malachite ($CuCO_3{\cdot}Cu(OH)_2$), and marble ($CaCO_3$ or $CaCO_3{\cdot}MgCO_3$). The lazurite and malachite samples were irregularly shaped, taken from natural rock. The marble sample was flat and partially polished. As expected, malachite and marble have the characteristic band for the carbonate around 1500 cm^{-1}, while lazurite has a metal oxide band around 1000 cm^{-1}, and malachite has hydroxide bands around 3400 cm^{-1}. These differences show that it is possible to spectrally distinguish rocks using the Meridian™.

The Meridian can also be used to examine coatings on materials. Figures 5 and 6 illustrate this application. Figure 5 compares the spectra from two flat and partly polished pieces of marble. The spectrum of the coated marble clearly shows the thin layer of material that has been applied to its surface to protect it from weathering. Figure 6 shows the differences between two different colors of

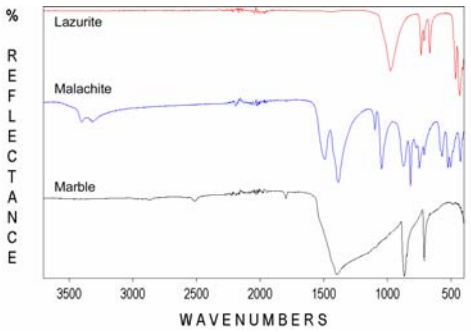

Figure 4. ATR Spectra of Rocks.

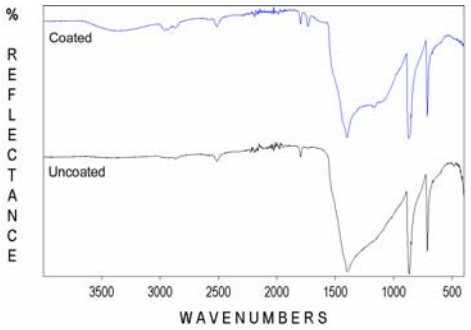

Figure 5. ATR Spectra of Coated and Uncoated Marble.

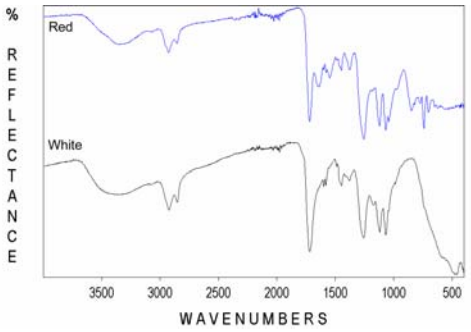

Figure 6. ATR Spectra of Two Colors of Paint on Stainless Steel.

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paint on a stainless steel tool holder.

SUMMARY

As demonstrated here, the Meridian™ is the state-of-the-art ATR nanosampler that readily analyzes extremely hard and corrosive materials. It also excels in examining other small samples and spots on larger materials for both quality control and research applications.

Harrick's Meridian™ ATR micro-sampler is *the* standard against which others are measured.

REFERENCES

[1]N.J.Harrick, *Internal Reflection Spectroscopy* (Harrick Scientific Corp., Ossining, New York, 1967).
[2]Registered Trademark of Reckitt and Colman, Inc.
[3]Manufactured by Macklanburg-Duncan Co.

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