

## THE PRAYING MANTIS

The Praying Mantis was the first generally available diffuse reflection attachment and remains the forerunner in the field. It incorporates two 6:1, 90° off-axis ellipsoids that form a highly efficient diffuse reflection illumination and collection system. This unique configuration deflects the specular reflectance away from the collecting ellipsoid, minimizing the associated spectral distortions. It also can be configured to study materials and reactions in controlled environments with the appropriate reaction chamber.

### APPLICATIONS

- ▶ For easy and reliable diffuse reflection analysis of solids and powders.
- ▶ Analysis of catalysts and other powders in a temperature and/or pressure controlled environment.

### FEATURES

- ▶ Highly efficient collection system.
- ▶ Minimizes the detection of the specular component.
- ▶ Ellipsoids pivot to provide easy access to the sampling area.
- ▶ Allows easy attachment of reaction chambers.
- ▶ Several models offered for compatibility with a wide range of IR-UV-Vis spectrometers.
- ▶ Harrick's exclusive PermaPurge™ allows rapid exchange with minimal interruption of the system purge.
- ▶ Optional references for FTIR and UV-Vis studies.

### INCLUDES

- ▶ Cart with two mounted alignment mirrors.
- ▶ Alignment post.
- ▶ Sample cart.
- ▶ Two sampling cups: 10mm dia. adjustable height and 3mm dia. adjustable microsampling.
- ▶ Funnel.
- ▶ Mating hardware for the specified spectrometer.



### ORDERING INFORMATION

	CATALOG NO.
Praying Mantis Diffuse Reflectance Accessory.....	DRP-XXX
Praying Mantis Kit, 110V (includes HVC Chamber with ZnSe windows and Temperature Controller).....	DRK-3-XXX
Praying Mantis Kit, 220V (includes HVC Chamber with ZnSe windows and Temperature Controller).....	DRK-4-XXX

### OPTIONS & REPLACEMENT PARTS

Alignment Fixture.....	DRP-ALN
Sampling Accessory Kit.....	DRP-SAP
Micro-sampling Cup, 0.03ml volume.....	DRP-SX3
Sampling Cup, 0.25ml volume.....	DRP-S10
KBr powder, 100g (FTIR reference and dilution material).....	KBR-100
Spectralon® UV-Vis Reference Disk for the Praying Mantis.....	DRP-SPR
Temperature Controller, 110V input, 24V output with USB adapter.....	ATK-024-3
Temperature Controller, 220/240V input, 24V output (CE marked) with USB adapter.....	ATK-024-4
Ambient Sample Chamber.....	FT-IR DRP-ASC
High Temperature, Low Pressure Reaction Chamber, 24V.....	HVC-DRM-5 (ZnSe) HVC-DRP-5 (KBr) HVC-VUV-5 (SiO <sub>2</sub> )
High Pressure Dome for the HVC Reaction Chambers (Max. Pressure: 500 psi).....	HVC-DWI-3 (ZnS) HVC-DWA-3 (SiO <sub>2</sub> )
Low Temperature, Low Pressure Reaction Chamber, 24V.....	CHC-CHA-3 (KBr) CHC-VUV-3 (SiO <sub>2</sub> )

The Praying Mantis™ was the first generally available diffuse reflection accessory (DRA) and remains the forerunner in the field today. It is ideal for reliable diffuse reflectance studies of powders and other rough surface solid samples.

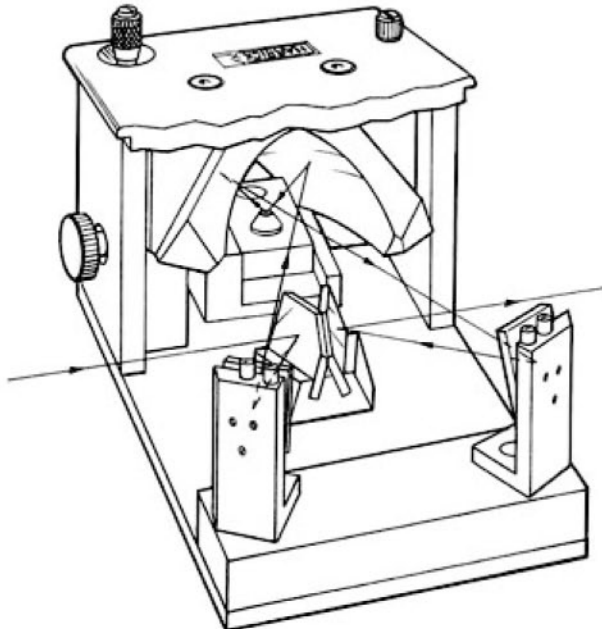


Figure 1. Interior View of the DRP.

The typical optical configuration of the Praying Mantis™ Diffuse Reflectance Attachments is shown in Fig. 1. The DRA incorporates two 6:1 90° off-axis ellipsoidal mirrors. One ellipsoid focuses the incident beam on the sample while the second collects the diffusely reflected radiation from the sample. Both ellipsoidal mirrors are tilted forward so the diffusely reflected radiation is collected at an azimuthal angle of 120°. This deflects the specularly reflected component behind the collection ellipsoid, minimizing the intensity of restrahten bands caused by the specularly reflected light. Most other commercially available attachments collect the diffusely reflected light at 180°, where the restrahten bands have maximum intensity. This optical geometry permits collection of up to 20% of all the diffusely reflected radiation, making the DRA quite practical for routine measurements.

The Praying Mantis™ can be used to examine powders and small solid samples. The sample is placed in one of the supplied sampling cups on the Praying Mantis™ sampling stage. The height of the stage can then be adjusted for optimal performance. The micrometer-style height adjust allows for accurate and reproducible positioning of the sample. For easy access to the sampling area, the Praying Mantis™ features the ability to flip its illumination and collection ellipsoids away from optical plane of the attachment.

The Praying Mantis™ also features PermaPurge™ and hence is enclosed in a purgeable box for rapid sample exchange with minimal interruption of the purge. This eliminates interference from water and carbon-dioxide bands in the infrared.

The Praying Mantis™ is ideal for studying samples in a controlled environment and several optional chambers are offered. Our Ambient Sample Chamber is designed for analysis of air-sensitive samples. The samples can be loaded in a glove box or similar enclosed environment. The chamber can then be sealed, removed from the glove box, and inserted in the Praying Mantis™ for analysis. This chamber features a removable stainless steel dome with two infrared or UV-Vis windows and a glass observation window.

Two reaction chambers (see separate data sheet) are also available. These reaction chambers are designed for operation in static or flow conditions. Our Low Temperature Chamber is designed for operation up to 1-2 ATM and for temperatures ranging from -150°C to 600°C. Our High Temperature, Low Pressure Chamber operates at temperature up to 910°C (under vacuum) and from pressures of 133 μPa (10<sup>-6</sup> torr) to 133 kPa (1 ktorr) with KBr windows or 1.5 MPa (11.3 ktorr) with ZnSe or UV-grade SiO<sub>2</sub> windows. With its optional High Pressure Dome, this chamber can withstand pressures up to 3.44MPa (25.8 ktorr). This chamber, with ZnSe infrared or UV-grade SiO<sub>2</sub> windows, can be purchased as part of a kit including the Praying Mantis™ and Temperature Controller.

Representative spectra recorded with the Praying Mantis are shown here in Figures 2 and 3. Note that Figure 3 was recorded using the DRA with its HVC reaction chamber.

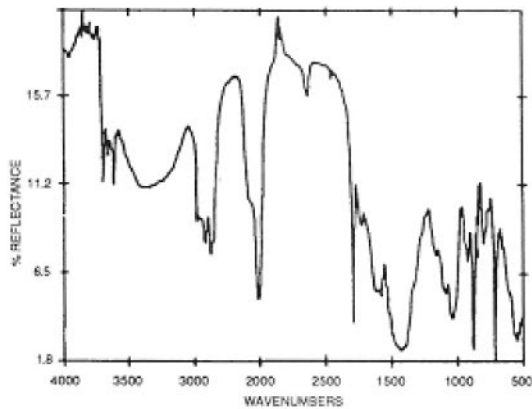


Figure 2. Diffuse Reflection of Chalk.

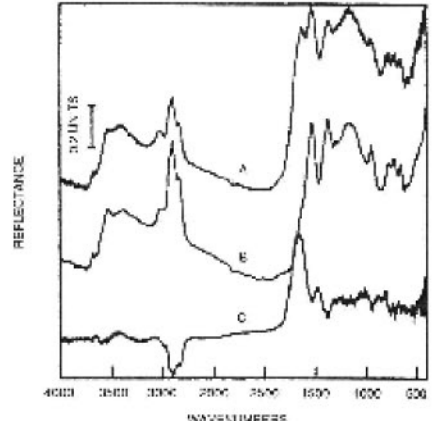


Figure 3. Diffuse Reflection of Wyodak Coal (A) after 24 hrs of oxidation at 2.4KPa at 393°C, (B) dried unoxidized samples, and (C) the difference spectrum (A-B).

## PRAYING MANTIS CATALYSIS RESEARCH DIFFUSE REFLECTION PACKAGE

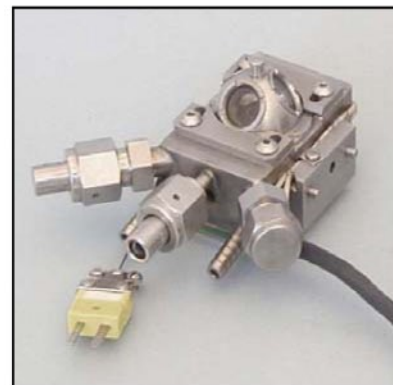
This Catalysis Research Package is a special offer, packaging our premier Praying Mantis with its High Temperature Reaction Chamber, Temperature Controller and all the sampling tools required. The Praying Mantis was the first generally available diffuse reflection attachment and remains the forerunner in the field. Its unique and highly efficient optical system deflects specular reflectance away from the collecting ellipsoid, minimizing spectral distortions. With its Reaction Chamber and Temperature Controller, the Praying Mantis is ideal for examining samples in low to ambient pressures and at high temperatures. Upgradeable for high pressure operation.

### APPLICATIONS

- ▶ Straightforward and reliable diffuse reflection analysis of solids and powders.
- ▶ Analysis of catalysts and other powders in a temperature and/or pressure controlled environments.

### FEATURES

- ▶ Praying Mantis Diffuse Reflectance Accessory
  - ▶ Highly efficient collection system.
  - ▶ Minimal collection of the specular component.
  - ▶ Easy access to the sampling area.
  - ▶ Straightforward attachment of reaction chambers.
  - ▶ Includes PermaPurge™ for rapid exchange with minimal interruption of the purge.
- ▶ High Temperature, Low Pressure Reaction Chamber
  - ▶ Designed for operation from high vacuum (133  $\mu$ Pa or  $10^{-6}$  torr) to 133 kPa (1 ktorr) with KBr windows or 1.5 MPa (11.2 ktorr) with ZnSe or SiO<sub>2</sub> windows.
  - ▶ Achieves temperatures up to 910°C (under vacuum).
  - ▶ Readily adapted with a High Pressure Dome for operation up to 3.44MPa (25.8 ktorr).
  - ▶ Three inlet/outlet ports provided for evacuating the cell and introducing gases.
  - ▶ Made from chemically resistant 316 stainless steel.
  - ▶ Optional cooling cartridge for moderate cooling or heating with a recirculator.
- ▶ Temperature Controller
  - ▶ Accurate temperature regulation from -200 to 1250°C for K-type thermocouples.
  - ▶ Cascade or regular operation.
  - ▶ Digital temperature readout in degrees Fahrenheit or Celsius.
  - ▶ Programmable through the keypad or the supplied RS485 port.
  - ▶ USB to RS-485 adapter for computer control.



### INCLUDES

- ▶ Diffuse Reflectance accessory with alignment fixture, alignment post, 10mm and 3mm sampling cups, funnel and mating hardware for the specified spectrometer.
- ▶ Reaction Chamber with K-type thermocouple, two ZnSe or UV quartz windows, a glass observation window and a screen set.
- ▶ Temperature Controller.

### ORDERING INFORMATION

Praying Mantis Catalysis Research Package, 110V.....CATALOG NO. DRK-3-XXX\*  
Praying Mantis Catalysis Research Package, 220/240V.....DRK-4-XXX\*

\*XXX indicates spectrometer make and model; compatible with a wide range of IR-UV-VIS spectrometers.

### OPTIONS

Cooling Cartridge.....HVC-COL  
Purge Shield.....DRP-PDR  
Ambient Sample Chamber.....*FT-IR* DRP-ASC (KBr) *UV-VIS* DRP-ASC-VUV(SiO<sub>2</sub>)  
High Pressure Dome for the HVC Reaction Chambers (Max. Pressure: 500 psi).....HVC-DWI-3 (ZnS).....HVC-DWA-3 (SiO<sub>2</sub>)  
Low Temperature, Low Pressure Reaction Chamber, 24 V.....CHC-CHA-3 (KBr).....CHC-VUV-3 (SiO<sub>2</sub>)