



ATR Sampling Accessories for Agilent Cary 630 FTIR Spectrometers

Technical Overview

Introduction

Attenuated total reflectance (ATR) is the most widely used sampling methodology for FTIR spectroscopy. This popularity is due to the ability to quickly and easily measure a broad range of sample types including liquids, solids, powders, semisolids, and pastes. Depending on the specific application or sample, different ATR sensors are employed. The Agilent Cary 630 FTIR accommodates a wide selection of ATR sensors, and features the ability to switch from one ATR sensor to another instantaneously.

For most applications, single reflection zinc selenide (ZnSe), diamond, and germanium (Ge) ATR sampling accessories are available for the Cary 630. These accessories are used with a sampling press, and are excellent for analyzing solid materials, as well as liquids, pastes, and gels. The diamond sensor is highly durable, and the best choice for harder materials. The ZnSe sensor is a good choice for softer solids, and is more affordable than the diamond ATR. The Ge sensor, with a shorter pathlength, is the best choice for highly absorbing samples. In addition, the five reflection ZnSe ATR sampling accessory is a great option for the analysis of liquids, pastes, and gels, where additional sensitivity is needed.



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Because these sampling technologies are custom engineered for the Cary 630, the analyst can have confidence in the results, whichever ATR sensor is chosen for a particular application. This custom engineering translates into the highest performance, sensitivity, and ease-of-use of any spectrometer in its class.

This Technical Overview reviews the ATR sensors available for the Cary 630, and summarizes which should be selected for a specific sample type.



ZnSe ATR

ZnSe is a semiconductor type material that has been used for many years as an ATR sensing element. It is relatively hard, has a broad wavelength range, and is insoluble in water. For this reason, it is an excellent choice for pliable solids, pastes, gels, and liquids. It can be used to analyze aqueous solutions in the pH 5–9 range. The Cary 630 has two variations of ZnSe sampling technology available: five reflection and single reflection sensors.

- **Single reflection ZnSe ATR**

Because of the relatively short pathlength of infrared light into the sample, this sensor is ideal for neat samples, that is, samples that are relatively concentrated or pure. The single reflection ZnSe is a good choice for identification of softer materials as well as viscous liquids. When measuring solids such as polymer films, it can be used with the Cary 630 pressure clamp to ensure good contact between the sample and sensing window.

- **Wavelength range**
5,100–600 cm^{-1}

- **Effective pathlength**
1.1 μm at 4,000 cm^{-1}
2.6 μm at 1,700 cm^{-1}
7.3 μm at 600 cm^{-1}

- **Sample types**
Soft solids (for example, textile fibers, polymer films), neat liquids, pastes, and gels

- **Five reflection ZnSe ATR**

The exceptional performance of the Cary 630 FTIR, combined with the increased pathlength of the five reflection ATR sensor, results in a spectrometer system of unsurpassed sensitivity. Lower concentration components in pastes, gels, and liquids can be measured. Solutes in dilute or concentrated aqueous solution in the pH range of 5–9 can also be analyzed. Since the five reflection sensor is recessed slightly in its stainless steel holder, it is ideal for analyzing nonviscous liquid samples. This sensor is a superior choice when qualitative or quantitative measurements are required. It is not recommended for use with solid materials, since it is not used with the pressure clamp.

- **Wavelength range**
5,100 cm^{-1} to 600 cm^{-1}

- **Effective pathlength**
5.5 μm at 4,000 cm^{-1}
13.0 μm at 1,700 cm^{-1}
36.5 μm at 600 cm^{-1}

- **Sample types**
Aqueous and nonaqueous solutions, viscous and nonviscous liquids, gels, and pastes

Diamond ATR

The use of diamond as an ATR material has revolutionized FTIR sampling. Harder samples, such as minerals and harder polymers, can be readily analyzed with this sensor, because it cannot be scratched. The diamond ATR is also resistant to strong acids and bases, and is excellent for measuring high or low pH aqueous solutions. The diamond ATR for the Cary 630 is a single reflection sensor used with the sample press to enable good contact between the material to be analyzed and the diamond surface. As a single reflection sensor, it is ideal for neat or pure substances that are particulates, powders, or other hard materials. The unique design of the diamond ATR for the Cary 630 results in high energy throughput, and the combination of spectrometer and diamond sampling technology typically outperforms other routine FTIR systems.

- **Wavelength range**
4,500 to 2,300 cm^{-1}
1,800 to 650 cm^{-1}
- **Effective pathlength**
1.1 μm at 4,000 cm^{-1}
2.6 μm at 1,700 cm^{-1}
7.3 μm at 600 cm^{-1}
- **Samples types**
All liquids, solids, gels, and hard materials

Ge ATR

Ge is a brittle, hard, semimetallic element with a high index of refraction that yields a shorter depth of penetration for infrared radiation. The Cary 630 FTIR uses a single reflection Ge ATR element that is an excellent choice for analyzing materials that are highly absorbing, or have highly scattering components. Samples such as polymers containing carbon black are often analyzed with the Ge ATR. O-rings, gaskets, and black rubber tires are all examples of materials that are well suited to analysis by the Cary 630 Ge ATR sampling accessory.

- **Wavelength range**
5,100 to 600 cm^{-1}
- **Effective pathlength**
0.15 μm at 4,000 cm^{-1}
0.36 μm at 1,700 cm^{-1}
1.02 μm at 600 cm^{-1}
- **Samples types**
Carbon black filled polymers

ATR sensors for the Cary 630

Whether your applications require the one reflection ZnSe, five reflection ZnSe, one reflection diamond, or one reflection Ge ATR, the Cary 630 delivers class leading performance. Unlike other FTIR spectrometers that use third-party accessories, sampling technology for the Cary 630 is custom designed by Agilent engineers, and perfectly matched to the optical characteristics of the spectrometer. The rugged, no-alignment design permits instantaneous exchange of these ATR sampling technologies so that any sample type you might face will readily be accommodated.

Click here to access the datasheets on each Cary 630 FTIR Accessory:

<http://www.agilent.com/en-us/products/ftir/ftir-benchtop-systems/cary-630-ftir-spectrometer#accessories>

ATR sampling technology available for the Agilent Cary 630 FTIR

ATR element	Wavelength range	Effective pathlength	Sample type	Pressure clamp
One-reflection ZnSe	5,100–600 cm^{-1}	1.1 μm at 4,000 cm^{-1} 2.6 μm at 1,700 cm^{-1} 7.3 μm at 600 cm^{-1}	Neat or concentrated; soft solids, pastes, gels, liquids, not strong acids or bases	Yes
Five-reflection ZnSe	5,100–600 cm^{-1}	5.5 μm at 4,000 cm^{-1} 13.0 μm at 1,700 cm^{-1} 36.5 μm at 600 cm^{-1}	Lower level components, more dilute solutions; pastes, gels, liquids, not strong acids or bases	No
One-reflection Diamond	4,500–2,300 cm^{-1} 1,800–650 cm^{-1}	1.1 μm at 4,000 cm^{-1} 2.6 μm at 1,700 cm^{-1} 7.3 μm at 600 cm^{-1}	Hard solids, particulates, polymers, pastes, liquids, all pH ranges	Yes
One-reflection Ge	5,100–600 cm^{-1}	0.15 μm at 4,000 cm^{-1} 0.36 μm at 1,700 cm^{-1} 1.02 μm at 600 cm^{-1}	Carbon black filled polymers	Yes

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