Datasheet

Scientific Raman Spectrometer ATR3120

Features

- High sensitivity detector;
- Android operating system, 8-inch capacitive touch screen;
- Detachable fiber optic Raman probe;
- Ultra-low noise circuit;
- Powerful PC-side spectrum analysis software;
- Peak search and display;
- USB 2.0;
- Friendly human-machine interface;

Application

- Nanoparticles and New Materials
- Research in Scientific Research Institutes
- Biological science
- Pharmaceutical engineering
- Forensic analysis
- Agriculture and food safety
- Gemstone
- Environmental science

Description

The ATR3120 desktop Raman spectrometer uses a cooled high-sensitivity CCD, which is suitable for long integration times. ATR3120 uses fiber optic probe, which is suitable for laboratory scientific research. The test results are accurate and reliable. The excellent low stray light design makes the ATR3120 adaptable to use in complex environments. Suitable for work in scientific research, food safety, pharmaceutical engineering and other fields.

ATR3120 has built-in multi-functional software that is shipped with the machine. After nearly a hundred versions of updates, the functions are very complete and stable, and it is suitable for the development of Raman research work.

Model	Wavelength Range (cm^{-1})	Resolution (cm^{-1})
ATR3120-27	250-2700	4~6
ATR3120-35	200-3500	6~8
ATR3120-42	200-4200	7~10

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Tel: +86-592-6102588

1. Working Principle

SERDS, also known as frequency shift excitation method, uses two slightly different wavelengths of laser to irradiate the sample to get two original Raman spectra. The fluorescence background does not move with the slight change of laser wavelength, but the position of Raman peak will change obviously. The difference spectrum is obtained by subtracting the two spectra. In the difference spectrum, the fluorescence background phase changes There is no fluorescence interference.

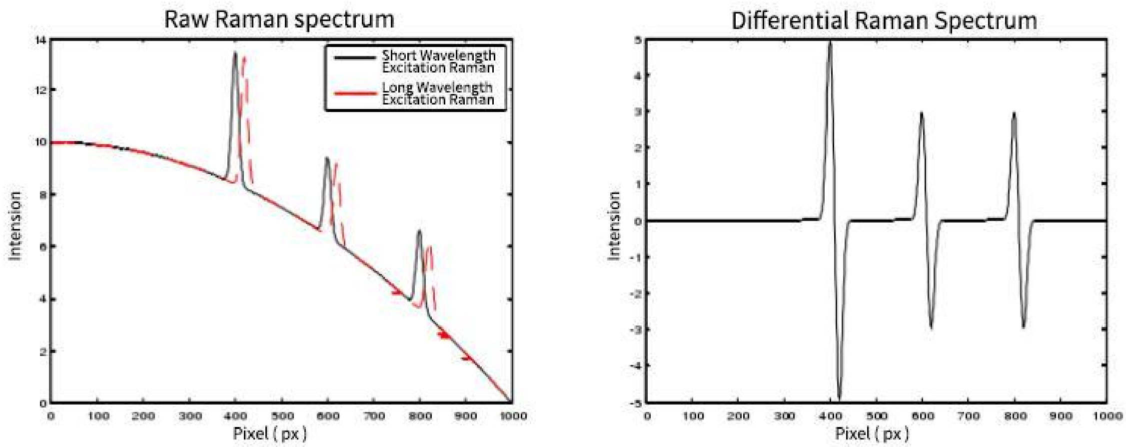

Fig. 1 (a) the original Raman spectra (the realized and dotted lines represent the Raman spectra excited by 784.5nm and 785.5nm laser respectively); (b) the differential spectra

In the ideal case, the normal Raman spectrum can be easily recovered from the difference spectrum by using the accumulation method and convolution method. However, the actual measured spectral signals are more or less noisy, such as dark current noise of photodetector, circuit thermal noise, ambient background light noise, stray light inside spectrometer, etc., as shown in Fig 2.5. The existence of noise will not only affect the measurement SNR, but also reduce the performance of the restoration algorithm.

Compared with the laboratory Raman system, the portable Raman spectrometer has worse signal-to-noise ratio and more serious noise interference. In addition to noise interference, the intensity of positive and negative peaks may be inconsistent and asymmetric in the actual differential spectrum, which will also reduce the performance of the differential spectrum restoration algorithm.

The intensity of Raman signal is inversely proportional to the fourth power of the wavelength. Although there is only a small difference between the two excitation wavelengths of the SERDs system, this small difference will lead to the asymmetry of Raman peak. The noise interference superimposed on the spectrum peak will also cause the spectrum peak asymmetry. In addition, the different temperature and the slight change of fluorescence characteristics (photobleaching) also lead to asymmetric peaks.

Optosky has developed a new differential Raman reconstruction algorithm raman, which can perfectly solve the problems of noise and asymmetry.

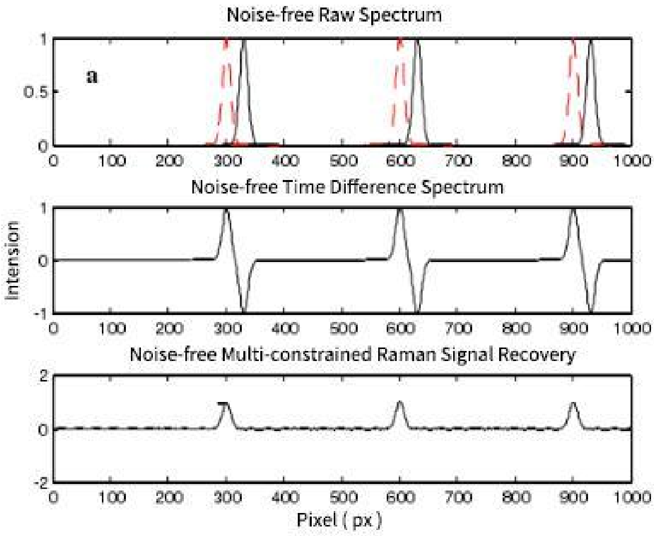

Fig.2signal recovery of differential Raman

2.Parameter

ATR3120 System			
Interface	USB 2.0		
Integration Time	4ms - 120s		
Supply Voltage	DC 5V(+/-5%)		
Working Temperature	-10~40 ℃		
Working Humidity	< 95%		
Dimensions(L*W*H)	$30\times22.5\times13.2\ cm^3$		
Weight	7.8 Kg		
Reliability			
Spectral Stability	σ/μ < 0.5% (COT 8 hours)		
Temperature Stability	Spectral shift ≤ 1 cm-1 (10-40 ℃)		
Spectral Intensity Change (in 5~40℃)	<±5%		
Optical Parameters			
Wavelength Range (cm^{-1})	250-2700	200-3500	200-4200
Resolution (cm^{-1})	4~6	6~8	7~10
SNR	>3000:1 (918 cm-1 of Acetonitrile， 10s accumulation, 200mW)		
Slit Wide	50 μm		
Focus	98 mm for incidence and output		
Detector			
Model	Ultra high sensitivity and fast cooling CCD		
Cooling temperature	-10 ℃		
Detection range	200-1100 nm		

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Effective pixel	2048pixels
Dynamic range	50000：1
Full well capacity	300 Ke-
Sensitivity	QE>40%, 6.5 μV/e-
Excitation	
Central wavelength	Built in two lasers with central wavelengths of 784.5nm & 785.5nm
Half peak width	0.08 nm
Output power	≥500 mW
Power reliability	σ/μ <±0.2%
Raman probe	
Working distance	6 mm
Transmittance	OD>8
NA	0.3
Aperture	7mm

3.Measured Spectrum

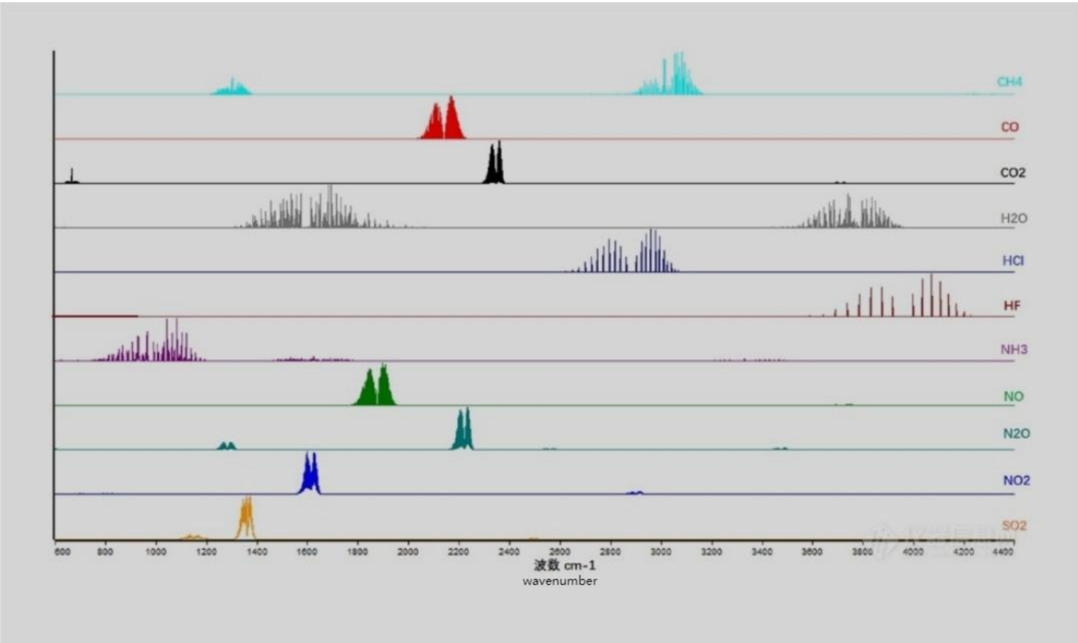

Fig.3 Measured Spectrum

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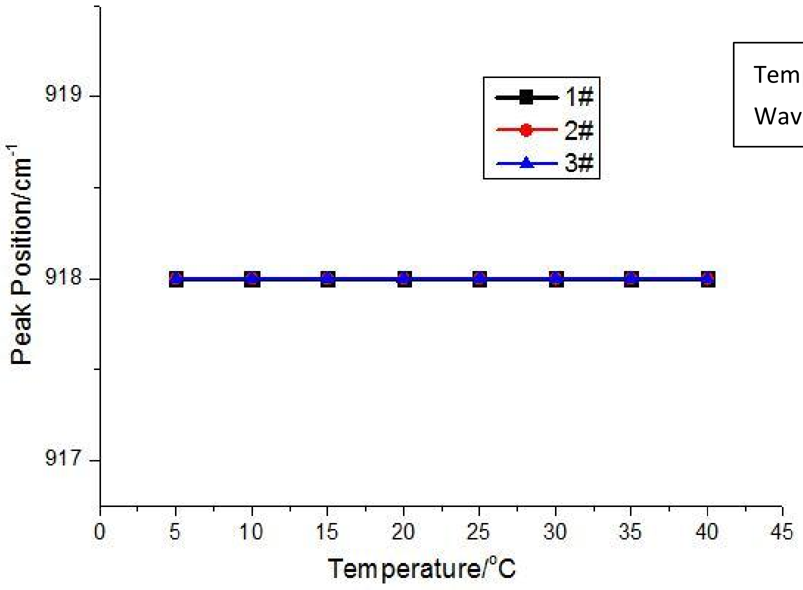
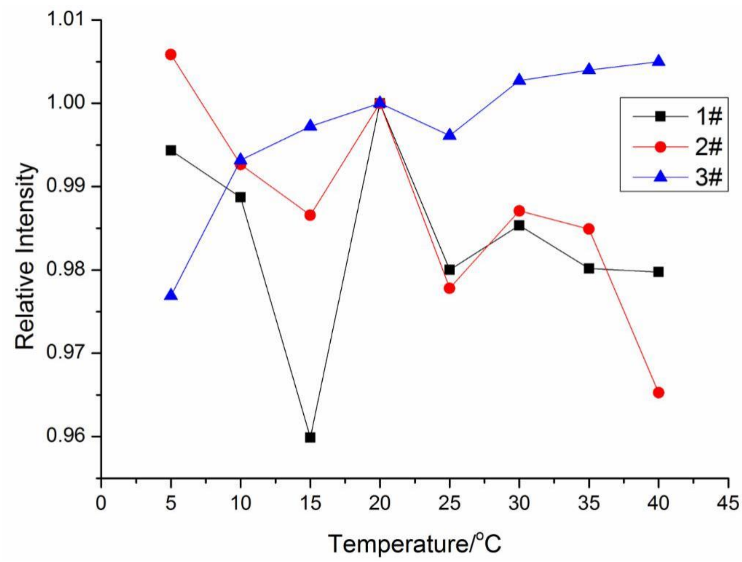
4. Reliability Test



Temperature range:5-40centigrade
Wavenumber shift:<1cm^{-1}

Fig.4Wavenumber shift test of ATR3120 SERDS(5~40°C)



Temperature range:5-40centigrade
Spectral intensity variation:<10%

Fig.5 signal strength stability test of ATR3120SERDS(5~40°C)

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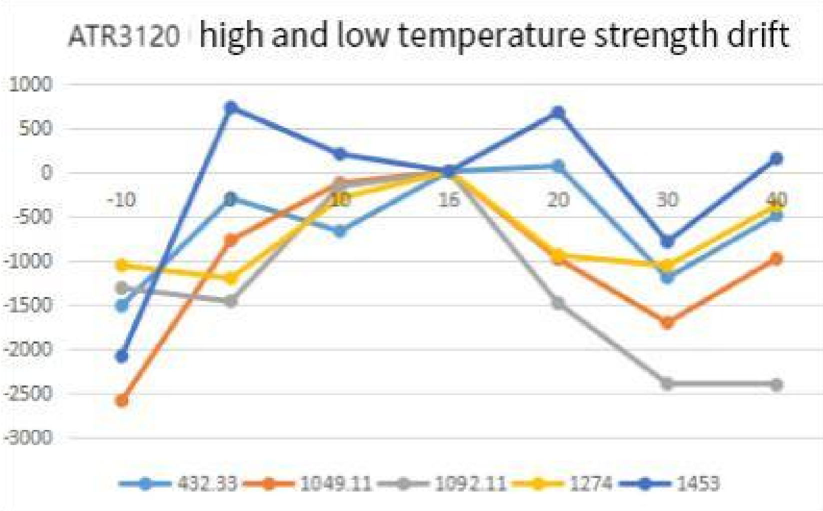

Fig.6 Peak intensity stability test of ATR3120 SERDS

5. Measurement Accessories

Fig.7 Solid and powder measuring probe

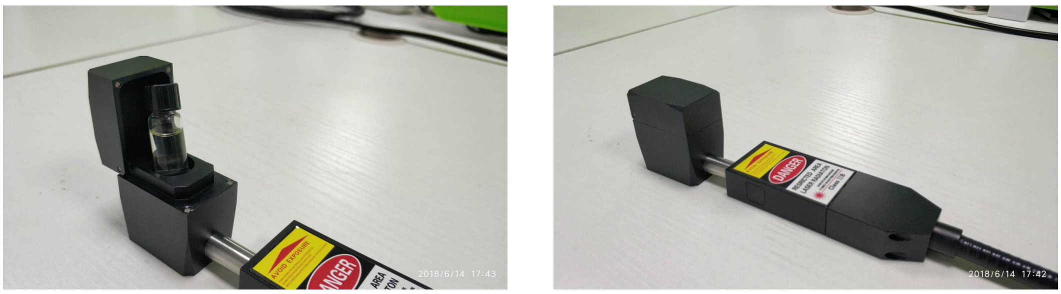

Fig.8 Liquid sample measuring cell(thermo bottle)

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Fig.9 Liquid sample measuring cell(liquid chromatography bottle,micro)(optional)

Fig.10 ATR20107 Raman probe gun (optional)

Fig.11 Test adjustment stand (optional)

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6. Differential Raman Application:

6.1. Identification and analysis of plastics by SERDS

Jiang Hong and others from the school of investigation and criminal science and technology of people's Public Security University of China used SERDS to inspect 42 plastic bottles of different brands, different manufacturers and different capacities. According to the SERDS, the samples can be divided into polyethylene and polyethylene terephthalate, and the Raman characteristic peaks of each type of samples are different. Using discriminant analysis method to analyze the processed spectral data, eight discriminant functions are established to predict the value of data variables. At the same time, the discriminant ability of the above discriminant functions is tested, and the discriminant distribution map is established. The centroids of nine groups of samples in the discriminant map are obviously distinguished, and the effect is better.

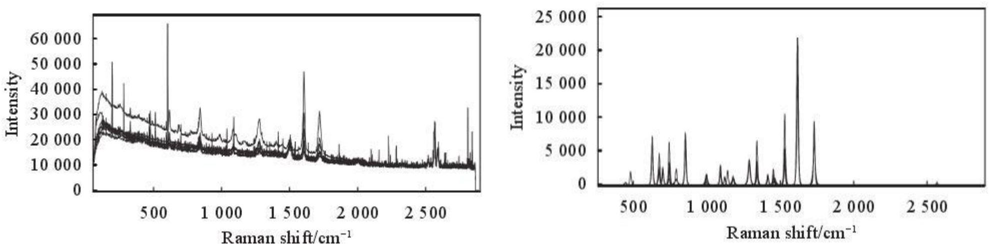

Fig. 12 Conventional Raman spectra (left) and differential Raman spectra (right) of plastic samples

5.2. Identification of sole materials by differential Raman

Sports shoes have become the necessities of people's daily travel. As a kind of common material evidence, sports shoes soles often appear in all kinds of criminal cases and traffic accident scenes. Through the inspection of the extracted material evidence, it can provide clues and directions for the detection of cases, and provide scientific evidence for the confirmation of crimes. With the rapid development of chemical and polymer materials, sole materials have evolved from leather and natural rubber (NR) to new materials with various properties.

At present, the main methods of testing sole materials are infrared spectroscopy, X-ray fluorescence spectrometry, scanning electron microscopy / energy dispersive spectrometry, etc. SERDS has the advantages of nondestructive testing, short processing time and simple operation. It can directly measure high fluorescence substances, filter out interference peaks (such as ambient light peak, PL peak, etc.), and improve the detection sensitivity and signal-to-noise ratio of the whole system.

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Jiang Hong and others from the school of investigation and criminal science and technology, people's Public Security University of China, used SERDS to test 40 white sports shoes soles, and combined with the system cluster analysis to process the experimental data, in order to provide a certain reference for the differentiation of sports shoes soles evidence in court science.

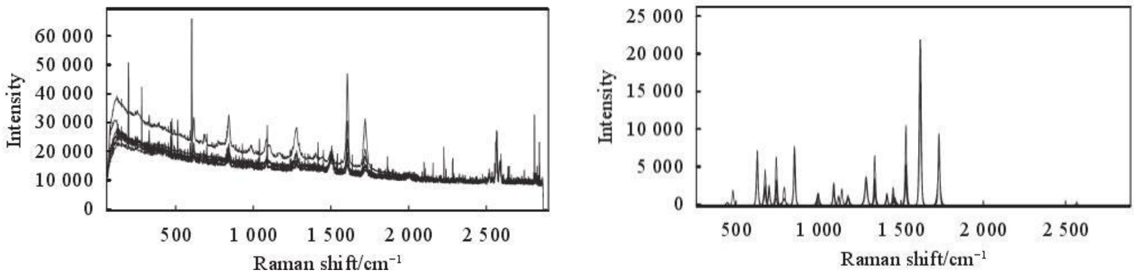

Fig. 13 differential Raman spectra of common sole materials (a) ethylene vinyl acetate copolymer EVA; (b) polyvinyl chloride (PVC)

5.3. SERDS for the identification and analysis of cigarette packaging film materials

Cigarette case outer packaging film refers to a layer of film wrapped outside cigarette case, which can be divided into three categories according to the main components: Biaxial polypropylene film (BOPP), cellulose film and ethylene propylene composite film (EPM). BOPP is most widely used in the production of cigarette packaging film in the market.

At present, the inspection methods of cigarette packaging film mainly include infrared spectroscopy, Raman spectroscopy, differential scanning calorimetry, X-ray fluorescence spectrometry, small angle laser scattering, overall separation trace comparison and so on. As a new method, SERDS has not been applied to the study of cigarette evidence. It not only has the characteristics of non-destructive testing materials and simple operation, but also can directly measure high fluorescent substances, filter out background noise, effectively reduce interference and improve the overall signal-to-noise ratio of the system.

Zhang Jin and others from the school of investigation and criminal science and technology of people's Public Security University of China have carried out a lot of experiments on different cigarette packaging materials by using SERDS, and achieved very good results.

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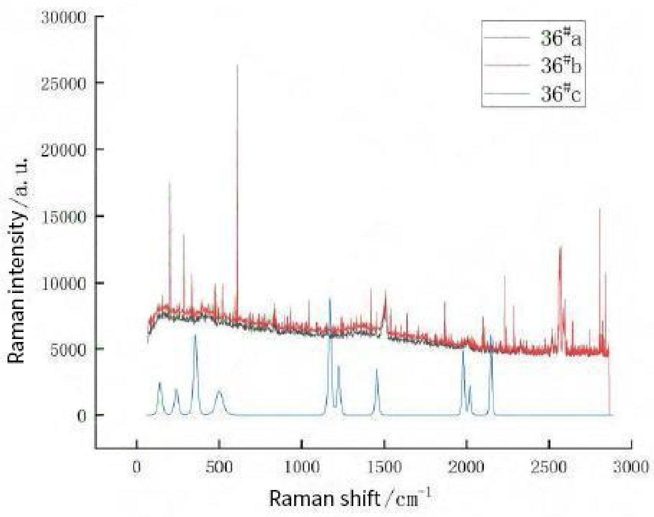

Figure 14 conventional Raman spectra (36 # A and 36 # b) and differential Raman spectra (36 # C) of cigarette case outer packaging film materials

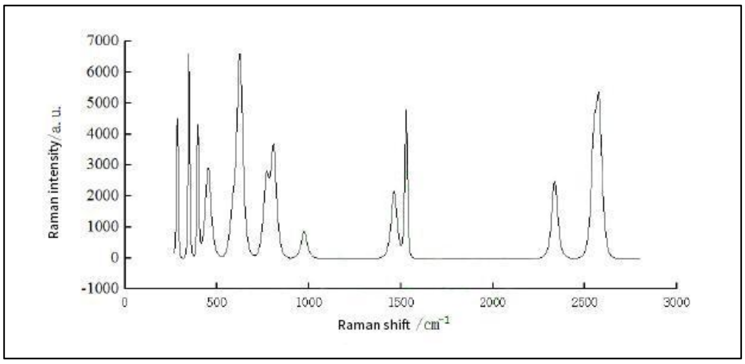

Fig. 15 differential Raman spectra of common cigarette packaging materials

5.4. Identification of Staphylococcus epidermidis by SERDS

Rapid detection of food borne pathogens has always been one of the hot issues in agricultural food safety, which needs to be paid enough attention by the whole society. Rapid detection of food borne pathogens has always been one of the hot issues in agricultural food safety, which needs to be paid enough attention by the whole society. With the advantages of accuracy and specificity, it has gradually become a strong technical support for agricultural food supervision.

Xu Mingzhu of Tarim University used the newly developed method of combining differential Raman technology and surface enhanced technology to obtain the fingerprint of related microorganisms, which was incorporated into the database. So as to achieve the rapid and accurate detection of all kinds of microorganisms.

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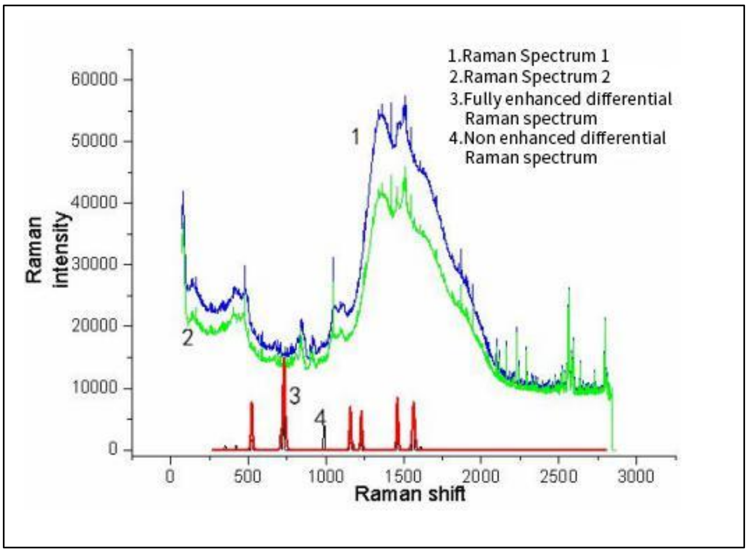

Fig. 16 differential Raman spectrum of Staphylococcus epidermidis; blue: Raman spectrum1 of Staphylococcus epidermidis with colloidal gold; green: Raman spectrum 2 of Staphylococcus epidermidis with colloidal gold; red: differential Raman spectrum of Staphylococcus epidermidis with colloidal gold; Black: differential Raman spectrum of Staphylococcus epidermidis without enhancer.

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