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General specification for Raman spectrometers

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General specification for Raman spectrometers

1 Scope

This standard specifies the terms and definitions, classification, requirements, test methods, inspection rules, markings, packaging, transportation, storage of Raman spectrometers.

This standard applies to Raman spectrometers, which use laser as the excitation light source (hereinafter referred to as the instrument). The instruments, which use other light sources, may make reference to this standard.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 191-2008 Packaging - Pictorial marking for handling of goods

GB/T 2829-2002 Sampling procedures and tables for periodic inspection by attributes (Apply to inspection of process stability)

GB 4793.1-2007 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

GB 7247.1-2012 Safety of laser products - Part 1: Equipment classification and requirements

GB/T 11606-2007 Methods of environmental test for analytical instruments

GB/T 13384-2008 General specifications for packing of mechanical and electrical product

GB/T 13966-2013 Terminology for analytical instruments

GB/T 17626.2-2018 Electromagnetic compatibility - Testing and measurement techniques - Electrostatic discharge immunity test

GB/T 17626.3-2016 Electromagnetic compatibility - Testing and

measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test

GB/T 17626.4-2018 Electromagnetic compatibility - Testing and measurement techniques - Electrical fast transient/burst immunity test

GB/T 17626.5-2019 Electromagnetic compatibility - Testing and measurement techniques - Surge immunity test

GB/T 18268.1-2010 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

GB/T 34065-2017 Safety requirements for analyzers

3 Terms and definitions

The terms and definitions as defined in GB/T 13966-2013, as well as the following terms and definitions, apply to this document.

3.1

Raman scattering

A phenomenon, where monochromatic incident light interacts with the medium to produce scattered light, which has a frequency different from the original incident light; meanwhile the relative frequency shift is symmetrically distributed on both sides of the incident light frequency.

3.2

Raman shift

The difference, BETWEEN the absolute wavenumber of incident light AND the absolute wavenumber of scattered light.

Note: The unit is cm^{-1} .

3.3

Raman spectrum

The distribution of Raman scattering intensity versus Raman shift.

3.4

Raman spectrometer

An instrument, which is used to collect Raman spectrum of specimen,

portable instruments (according to the group III conditions), after subject to the test of upper temperature limit and lower temperature limit of instrument, the spectral resolution and shift accuracy shall meet the requirements of 5.3.

The portable instrument shall meet the requirements of 5.3, after the vibration test.

The portable instrument's electrostatic discharge immunity, radio frequency electromagnetic field radiation immunity, electrical fast transient pulse group immunity, surge (shock) immunity, shall meet the requirements of Table 1 in GB/T 18268.1-2010.

5.7 Transportation, transportation, storage

When the instrument is transported and packaged, it shall select the test conditions for transportation and storage, according to the requirements of the environmental condition grouping in Table 1 of GB/T 11606-2007. After the test according to 6.12, the package shall not have significant deformation or damage; the instrument shall not have mechanical damage, such as deformation or loosening, peeling off of coating, etc.; the spectral resolution and shift accuracy shall meet the requirements of 5.3.

6 Test method

6.1 Preparation before test

Set the instrument parameters, according to the requirements of the instrument manual, such as laser wavelength and power, objective lens, slit width, grating line, other related conditions. The laser power is the nominal power OR the recommended value in the instrument manual. When testing the instrument, it shall indicate the environmental temperature, the wavenumber measurement range declared by the instrument, the wavelength and power of the excitation light, the size of the slit, the number of grating lines and focal length of the spectroscopic system, the sampling integration time, as well as other instrument setting conditions. For confocal Raman microscopy spectrometers, it shall also indicate the obvious micro objective lens, pinhole size, as well as other instrument parameters, which are closely related to the confocal performance.

Unless otherwise specified, the following test methods from 6.2 to 6.8 are required to be carried out, under the same conditions as above.

6.2 Test conditions

After the instrument has been prepared for the test, the performance test shall be started under the following test conditions:

- a) Unless otherwise specified, the test shall be carried out under the conditions specified in 5.1; the temperature fluctuation shall not exceed $\pm 2\text{ }^{\circ}\text{C}$;
- b) The instrument shall be preheated, in accordance with the requirements of the instrument specification, before the test;
- c) Test supplies: Element lamps: neon lamps, argon lamps, mercury lamps, element lamps of other wave band, etc.;
- d) Test sample: monocrystalline silicon (111); elemental sulfur (analytical pure), naphthalene (analytical pure), polystyrene flakes.

6.3 Functional inspection

In accordance with the provisions of 5.2, carry out visual observation and hand-feeling inspection, item by item.

6.4 Spectral resolution

Turn off the laser. Within the measurable spectrum range of the instrument, select the appropriate characteristic spectral lines of the element lamp, near the lower limit, upper limit, middle, respectively (see Appendix A for example). After the intensity of the light, which is output by the element lamp, is attenuated, introduce the measurement optical path of the spectrometer. Select three characteristic spectral lines of strong signals, at approximately equal interval, for measurement. Measure and record the full width at half maximum of each spectral peak of the element lamp. Repeat the measurement 6 times. Take the average value as the resolution of each band, under the corresponding excitation wavelength. Take the maximum value as the spectral resolution of the instrument.

6.5 Shift accuracy

Turn on the laser. According to the test conditions in 6.2, place the standard sample at the focus of the instrument signal acquisition probe. Measure the Raman spectrum of the reference sample, according to the wavenumber measurement range, which is declared by the instrument. In the range of $50\text{ cm}^{-1} \sim 200\text{ cm}^{-1}$, measure the Raman peak of elemental sulfur, at 153.8 cm^{-1} . In the range of $200\text{ cm}^{-1} \sim 2000\text{ cm}^{-1}$, measure the Raman peak of polystyrene, at 1001.4 cm^{-1} . In the range of $2000\text{ cm}^{-1} \sim 4000\text{ cm}^{-1}$, measure the Raman peak of naphthalene, at 3056.4 cm^{-1} . Record the shift value of the selected characteristic peak. Repeat the measurement 3 times. Calculate the difference, BETWEEN the measured shift value of the corresponding characteristic peak AND the standard shift value (see Appendix B), according to formula (1). Take the difference, which has the largest absolute value, as the shift accuracy of instrument.

6.11.3.1 Electrostatic discharge immunity

Carry out the test, in accordance with the contact discharge test procedure, which is specified in GB/T 17626.2-2018.

6.11.3.2 Radio frequency electromagnetic field radiation immunity

Carry out the test, in accordance with the procedure, which is specified in GB/T 17626.3-2016.

6.11.3.3 Electrical fast transient pulse group immunity

Carry out the test, in accordance with the procedure, which is specified in GB/T 17626.4-2018.

6.11.3.4 Surge (shock) immunity

Carry out the test, in accordance with the procedure, which is specified in GB/T 17626.5-2019.

6.12 Transportation, transportation, storage test

When the instrument is in the packaged state, it is tested according to the methods in Chapter 8, Chapter 15, Chapter 16, Chapter 17, Chapter 18 in GB/T 11606-2007.

7 Inspection rules

7.1 Classification of inspections

Instrument inspection is divided into exit-factory inspection and type inspection.

7.2 Exit-factory inspection

7.2.1 See Table 2 for the item categories of the exit-factory inspection.

7.2.2 Each instrument shall be qualified in the inspection. If the exit-factory inspection fails OR if there is nonconformances, it shall be reworked and re-inspected. Only after the re-inspection of all items are qualified, it can be exit-factory.

7.3 Type inspection

7.3.1 Timing of inspection

Type inspection is carried out in one of the following situations:

- a) When the design is type-finalized OR the production is type-finalized;

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