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Method for testing the refractive index of crystals

晶体折射率的试验方法

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7 Measurement Environment

The measurement environment requirements are as follows:

a) Temperature. 20.0°C~23.0°C, with a temperature change of no more than 1.0°C±0.1°C during the measurement process;

b) Relative humidity. not greater than 65%;

c) Vibration. Meets the equipment's vibration requirements in relation to the environment;

d) Cleanliness. better than Class 10,000.

8.1 Preparation

8.1.1 Turn on the refractive index measuring instrument, confirm that the goniometer, light source, detector, computer, etc. are all in normal working condition, and perform instrument calibration.

8.1.2 According to the requirements of refractive index measurement, select the light source and detector of the corresponding wavelength (spectral line) to obtain high-quality parallel monochromatic light.

8.1.3 The cleaned crystal prism sample is stably and firmly fixed on the sample support stage. After 30 minutes, the prism prism is adjusted. Side AA' is perpendicular to the main axis of the goniometer.

8.2 Measuring the degree of the refracting angle of a prism When light waves are incident on the two light-transmitting surfaces of the crystal prism, the resulting two reflected images are projected sequentially onto the crosshairs of the detector camera. At the center of the wire, record the difference theta (°) between the two readings taken during the rotation of the sample support stage. The refraction angle alpha = 180 - theta. Repeat the above measurement multiple times (not...). The arithmetic mean of less than 3 measurements.

8.3 Measuring the minimum deviation angle delta

8.3.1 When monochromatic light of different wavelengths is incident on one of the light-transmitting surfaces of a prism, and the test crystal sample is an optically isotropic crystal (vertical...), In the case of a cubic crystal system, the refracted light can be observed using a detector camera behind another light-transmitting surface. When the prism is located at the position of minimum deviation angle, the deviation of the refracted light is... The vibration direction is perpendicular to one of the principal axes of the refractive index of the crystal; when the tested crystal sample is a uniaxial crystal (including trigonal, tetragonal, and hexagonal crystal systems) and When dealing with biaxial crystals (including orthorhombic, monoclinic, and triclinic crystal systems), two refractive inflections with different deflection angles can be observed using a detector camera behind another light-transmitting surface. When the prism is at its minimum deflection angle, the polarization directions of the two refracted rays are either parallel to or perpendicular to one of the principal axes of the crystal's refractive index. direction.

8.3.2 Rotate the sample stage and measure the minimum deflection angle of the beam whose polarization direction is parallel to the principal axis of the refractive index (generally AA'). When it is observed that the beam deflects in the opposite direction after reaching a certain deflection point, this is the position of minimum deflection angle. The sample stage is then fixed at this point. Record the goniometer reading at the inflection point. Rotate the sample stage so that the other light-transmitting surface of the prism becomes the incident surface, repeat the above steps, and record the reading. The position of the other minimum deviation angle corresponds to the reading of the goniometer. Half of the difference between these two readings is the minimum deviation angle delta.

8.3.3 Repeat the steps in

8.3.2 to determine the minimum deflection angle of the beam whose polarization direction is perpendicular to the principal axis of the refractive index, and obtain this refraction. The minimum deflection angle corresponding to the beam.

8.3.4 For biaxial crystals, the same experiment should be performed with a different prism to obtain the three principal refractive indices at different wavelengths. In the above experiment, each data point was measured at least 6 times. After taking the arithmetic mean to obtain the delta value, the main wavelength of different wavelengths was obtained using formula (2). Refractive index.

8.4 Data Processing Using the least squares method, the principal refractive indices n1, n2, and n3 at different wavelengths were measured, and the Selmeier dispersion equation was applied. By fitting the equation, we can obtain the coefficients Ai, Bi, Ci, and Di in the equation, and thus obtain the refractive index dispersion curve, as shown in equation (3).

9 Measurement uncertainty

9.1 Sources of Measurement Uncertainty The sources of measurement uncertainty are as follows:

a) Uncertainty introduced by the perpendicularity of the optical axis of the sample crystal to the normal of the bisector of the prism apex angle;

b) Uncertainty introduced by the parallelism of monochromatic light;

c) Uncertainty introduced by changes in ambient temperature during measurement;

d) Uncertainty introduced by the measuring instrument;

e) Uncertainty introduced by repeated measurements.

9.2 Evaluation of Measurement Uncertainty Components The measurement uncertainty components are evaluated as follows:

a) The uncertainty introduced by the perpendicularity of the optical axis of the sample crystal to the normal of the bisector of the prism apex angle can be ignored;

b) The uncertainty introduced by the parallelism of monochromatic light can be ignored;

c) The uncertainty introduced by changes in ambient temperature can be ignored under the test conditions;

d) The uncertainty u12 introduced by the measuring instrument is a Type B uncertainty, given in the equipment calibration report;

e) The uncertainty u11 introduced by repeated measurements is a Type A uncertainty, calculated using equation (4).

9.3 Combined Standard Uncertainty The combined standard uncertainty un introduced by refractive index measurement can be calculated using equation (5).

9.4 Expanded Uncertainty With a coverage factor of k=2, the expanded uncertainty u(n) of the refractive index n of the sample to be tested is given by equation (7). u(n) = k·un (7)