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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 20975.25-2020

Replacing GB/T 20975.25-2008

Methods for the chemical analysis of aluminium and aluminium alloys - Part 25: Determination of element contents - Inductively coupled plasma atomic emission spectrometry

铝及铝合金化学分析方法 第25部分：元素含量的测定 电感耦合等离子体原子发射光谱法

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1 Scope

China's national multi-element method for the chemical analysis of aluminium and aluminium alloys by inductively coupled plasma atomic emission spectrometry. It is Part 25 of GB/T 20975 and specifies the determination of the contents of the alloying and impurity elements in aluminium and aluminium alloys by ICP-OES. The GB/T 20975 series is largely a collection of single-element methods, each with its own dissolution, separation and measurement, and each occupying a laboratory for a working day. This part replaces that pattern where it can. The sample is dissolved once, and every element of interest is measured simultaneously from the same solution against matrix-matched calibration standards, which is the reason ICP emission displaced classical analysis in metals laboratories: the analysis time no longer depends on how many elements are wanted. For aluminium that matters more than for most metals, because an aluminium alloy is defined by a long list of elements at once. Silicon, iron, copper, manganese, magnesium, chromium, nickel, zinc, titanium, zirconium, vanadium, lead, tin, gallium and boron all appear in the

composition tables, some as alloying additions and some as impurities with limits, and a certificate has to state them all. What the standard has to fix is what makes the simultaneous measurement trustworthy: the dissolution, which for silicon-bearing alloys is the difficult step; the choice of analytical lines and the spectral interferences between them, which in an aluminium matrix are numerous; the matrix matching of the calibration solutions; the internal standardisation; and the working ranges and precision for each element. Issued on 2 June 2020 and in force since 1 April 2021, it replaces GB/T 20975.25-2008.

This Part of GB/T 20975 specifies the determination of the contents of silicon, iron, copper, gallium, magnesium, manganese, chromium, nickel, zinc, titanium, silver, boron, bismuth, lithium, lead, tin, vanadium, zirconium, barium, beryllium, calcium, cadmium, cobalt, erbium, hafnium, indium, potassium, sodium, molybdenum, neodymium, phosphorus, antimony, scandium, strontium, tungsten, yttrium, and ytterbium in aluminum and aluminum alloys by inductively coupled plasma atomic emission spectrometric method. This Part applies to the determination of the contents of silicon, iron, copper, gallium, magnesium, manganese, chromium, nickel, zinc, titanium, silver, boron, bismuth, lithium, lead, tin, vanadium, zirconium, barium, beryllium, calcium, cadmium, cobalt, erbium, hafnium, indium, potassium, sodium, molybdenum, neodymium, phosphorus, antimony, scandium, strontium, tungsten, yttrium, and ytterbium in aluminum and aluminum alloys. The determination range is shown in Table 1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 8005.2, Terms of aluminium and aluminium alloys -- Part

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 8005.2 apply.

4 Method summary

Depending on the type of alloy and the content of elements, the following method is used to dissolve the specimen. - Specimens decomposed by hydrochloric acid and hydrogen peroxide; - Specimens decomposed by a mixture of hydrochloric acid and nitric acid; - Specimens decomposed by sodium hydroxide solution and hydrogen peroxide; - Specimens decomposed by a mixture of hydrochloric acid and nitric acid, and hydrofluoric acid. After specimen decomposition, inductively coupled plasma atomic emission spectrometry (ICP-AES) is used for determination. The matrix matching method is used to

correct for the influence of the matrix on the determination.

5 Reagents

Unless otherwise specified, only reagents confirmed to be analytically pure and laboratory Grade II water are used in the analysis.

5.1 Pure aluminum (wAl >= 99.999%).

5.3 Hydrochloric acid (rho =

1.19 g/mL), guaranteed reagent.

5.4 Nitric acid (rho =

1.42 g/mL), guaranteed reagent.

5.5 Hydrofluoric acid (rho =

1.14 g/mL), guaranteed reagent.

5.6 Perchloric acid (rho =

1.76 g/mL), guaranteed reagent.

5.7 Hydrochloric acid (1+1).

5.8 Nitric acid (1+1).

5.9 Mixed acid. mix 3 portions of hydrochloric acid (5.7) and 1 portion of nitric acid (5.8).

5.10 Sodium hydroxide solution (400 g/L).

5.11 Aluminum-based solution (20 mg/mL). Weigh

20.00 g of pure aluminum (5.1) into a 1000 mL beaker. Cover with a watch glass. Add hydrochloric acid (5.7) in portions, totaling 600 mL. After the vigorous reaction stops, heat slowly until completely dissolved. Then add a few drops of hydrogen peroxide (5.2). Boil for several minutes. Cool. Transfer the solution to a 1000 mL volumetric flask. Dilute to the mark with water. Shake well.

5.12 Standard stock solutions for each analytical element. preferably prepared using certified national standard solutions; or see Annex A.

5.13 Standard solution.

a) Principles for preparing multi-element standard solutions. Elements that chemically interfere with each other, produce precipitation, or cause spectral interference shall be prepared in groups.

b) Dilute the standard stock solution (5.12) to 100 μg/mL. Maintain the same acidity as the standard stock solution (dilute before use).

c) Dilute the standard stock solution (5.12) to 10 μg/mL. Maintain the same acidity as the standard stock solution (dilute before use).

6 Instruments

Inductively coupled plasma atomic emission spectrometer. The instrument shall meet the following conditions. - The spectrometer has vacuum or gas-expelling functions to ensure stable test signals for elements at wavelengths below 200 nm. - The instrument's resolution is less than

0.005 nm (at 200 nm).

7 Specimens

Process the sample into fragments with a thickness of no more than 1 mm.

8 Analysis steps

8.1 Test material According to the sample dissolution method adopted, weigh the corresponding mass (m0) of the specimen (Chapter 7) according to Table 2 or Table 3, accurate to 0.0001 g. not allow the filter paper to burn). Then ignite at 800°C for 5 min. Cool. Add 5 mL of hydrofluoric acid (5.5). Add nitric acid (5.8) dropwise until the solution is clear. Add 1 mL of perchloric acid (5.6). Heat to evaporate to dryness. Cool. Dissolve the residue with 5 mL of hydrochloric acid (5.7). Combine this test solution with the original filtrate. Dilute to the mark. Mix well. If necessary, dilute the test solution according to the working curve range.

8.4.2 Dissolution method II

8.4.2.1 This dissolution method is applicable to the determination of the contents of iron, copper, magnesium, manganese, gallium, titanium, vanadium, indium, tin, lead, bismuth, antimony, chromium, zinc, nickel, cadmium, beryllium, boron, strontium, calcium, silver, barium, cobalt, lithium, molybdenum, neodymium, yttrium, ytterbium, and scandium in aluminum and aluminum alloys.

8.4.2.2 Place the test material (8.1) weighed according to Table 2 into a 250 mL beaker. Add 25 mL of mixed acid (5.9). After the vigorous reaction stops, heat at a low temperature until the test material is completely dissolved. Cool to room temperature.

8.4.2.3 When the silicon mass fraction is greater than 0.5%, if there is insoluble residue, filter the test solution into a volumetric flask of the corresponding volume in Table 2. Wash the residue. Place the residue along with the filter paper in a platinum crucible. Ash (do not