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Analysis method of hydrogen in liquid aluminium and aluminium alloys the method of the closed gas loop circulation

铝及铝合金液态测氢方法 闭路循环法

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1 Scope

This Standard specifies the measurement principle, instrument requirements, test conditions, test procedures, and test report of the closed gas loop circulation method for measuring hydrogen content in liquid aluminum and aluminum alloys.

This Standard applies to the determination of hydrogen content in liquid aluminum and aluminum alloys.

2 Measurement principle

The closed gas loop circulation method uses a circulation system to promote the diffusion of hydrogen in the aluminum melt into a quantitative volume of inert gas, until the hydrogen partial pressure reaches equilibrium. It uses the thermal conductivity test principle to test the change in thermal conductivity of circulating gas due to hydrogen, and measure the partial pressure of hydrogen P_i. The calculation method of hydrogen content is as shown in formula (1):

$$[H] = KS_0 \sqrt{P_i/101.3} \qquad \cdots\cdots(1)$$

where:

[*H*] - the hydrogen content, in cubic centimeter per 100 grams of aluminum (cm^3/100 g Al);

*P*i - the hydrogen partial pressure, in kilopascal (kPa);

K - the alloy correction coefficient, determined by referring to formula (2). The correction coefficient *K* of commonly used aluminum and aluminum alloys is shown in Table 1;

S_0 - the solubility of hydrogen in pure aluminum, which is a function of temperature, as shown in formula (3), in cubic centimeter per 100 grams of aluminum (cm^3/100 g Al).

3.5 Repeatability: relative standard deviation ≤ 2.5 %.

3.6 Calibration error: ≤ 5 %.

3.7 Directly display hydrogen content.

4 Test conditions

4.1 Environmental requirements: temperature 0 °C ~ 50 °C, no electromagnetic interference that affects the normal operation of the instrument, and no corrosive gases.

4.2 Carrier gas source: selected according to the requirements of the instrument.

4.3 Hydrogen measuring probe: selected according to the requirements of the instrument, and it will not pollute the aluminum melt being measured under the test conditions.

4.4 Temperature measurement probe: selected according to the requirements of the instrument, and it will not pollute the aluminum melt being measured under the test conditions.

5 Test procedures

5.1 Instrument calibration

5.1.1 The instrument shall be carefully inspected and tested before use.

5.1.2 The instrument shall be tested with hydrogen in nitrogen standard gas and meet the requirement of calibration error.

5.2 Instrument preheating

Before using the instrument, it shall be powered on and preheated for 10 minutes.

5.3 Probe preheating

The hydrogen measuring probe shall be fully preheated according to the requirements of the selected instrument before use.

5.4 Data measurement

When measuring hydrogen, the measurement shall be repeated multiple times. When the difference between two consecutive data does not exceed the requirements in Table 2, the measurement is completed. The temperature shall be measured simultaneously with each measurement.

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