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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 39859-2021

Gallium-based liquid metal

镓基液态金属

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1 Scope

China's national standard for gallium-based liquid metals. Gallium melts at 30 degrees C, and alloyed with indium and tin it stays liquid well below room temperature - which gives a metal that is fluid at ambient without being mercury. That comparison is the point: gallium alloys have the electrical and thermal conductivity of a metal and the fluidity of a liquid, without mercury's toxicity and vapour pressure. The applications follow directly. They are the highest performance thermal interface materials available, conducting heat between a chip and its heatsink an order of magnitude better than any grease. They are used as flexible conductors in stretchable electronics, as the coolant in some high-flux applications, and in printed and reconfigurable circuits. The property that constrains them is aggressive alloying with aluminium, which they embrittle catastrophically - so the packaging and the surfaces they touch have to be specified with care.

This document specifies the technical requirements, test methods, inspection rules, marking, packaging, transportation, storage, as well as accompanying documents and order forms for gallium-based liquid metals. This document applies to gallium-based liquid metals used for cooling fluids, conductive fluids, thermal interface materials, electronic pastes, and magnetic fluid materials.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document

and are indispensable for its application. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 8170, Rules of rounding off for numerical values & expression and judgment of limiting values

GB/T 1024, Methods of viscosity measurement

GB/T 22588, Determination of thermal diffusivity or thermal conductivity by the flash method SY/T 5370, Test method for surface tension and interfacial tendon YS/T 1256, Nonferrous metal materials - Specific heat capacity testing - Differential scanning calorimetry YS/T 1257, Nonferrous metal materials - Enthalpies of fusion and crystallization testing-Differential scanning calorimetry YS/T 1258, Nonferrous metal materials - Melting and crystallization temperatures - Thermal analysis

3 Terms and definitions

The following terms and definitions are applicable to this document.

3.1 Melting temperature

5.2.7 The determination of specific heat capacity shall comply with the provisions of YS/T 1256.

5.2.8 The determination of enthalpy of melting shall comply with the provisions of YS/T 1257.

6.1 Inspection and acceptance

6.1.1 The product shall be inspected by the quality inspection department of the supplier to ensure that the product conforms to the provisions of this document (or order form), and the accompanying documents shall be filled out.

6.1.2 The buyer can inspect the received products according to the provisions of this document. Where the inspection results are inconsistent with the provisions of this document, they shall be sealed separately, which, within 30 days from the date of receipt of the product or within the time specified in the sales contract, shall be submitted to the supplier in writing, and negotiated and solved by both the supplier and the buyer. If arbitration is required, arbitration sampling shall be carried out jointly by both the supplier and the buyer in the products received by the buyer.

6.2 Batching Products shall be submitted for acceptance in batches. Each batch shall consist of products of the same heat number and the same type. The total amount of each batch shall not exceed 200 kg.

6.3 Sampling Randomly take 5% of the number of bottles from each batch of products (not less than 5 bottles; where the batch is less than 5 bottles, take all); take 5 g ~ 25 g from each bottle; mix them evenly.

6.4 Inspection items Each batch of products shall be inspected for appearance quality and physical properties according to the requirements of Chapter 4 and the test methods of Chapter 5.

6.5 Determination of test results

6.5.1 When the appearance quality inspection is unqualified, judge the batch of products as unqualified.

6.5.2 If the melting temperature, thermal conductivity, and electrical conductivity fail to pass the inspection, a double number of samples shall be taken from this batch of

e) outer box size;

f) production date;

g) markings such as anti-pressure and anti-dumping.

7.2 Packaging

7.2.1 Inner package The product comes in a single package. After the products are melted, put them into plastic bottles such as polypropylene; the net weight of each bottle shall be no more than 1 kg, and it shall be filled with inert gas or vacuum sealed. If the buyer has special requirements, it will be indicated in the order form after negotiation and confirmation between the supplier and the buyer.

7.2.2 Outer package The outer packaging of the product shall be firm and meet the requirements of anti- pressure, shock-proof and moisture-proof.

7.3 Transportation During transportation of the product, squeezing, inversion, sun exposure, rain and bumping shall be avoided.

7.4 Storage The product shall be stored in a well-ventilated, dry storage room where the ambient temperature is 0 °C ~ 40 °C and the relative humidity is not more than 70%. There shall be no corrosive gases such as acid and alkali in the room. The packing box shall be elevated, at least 20 cm above the ground, and at least 50 cm away from walls, heating equipment or air conditioning equipment.

7.5 Accompanying documents Each batch of products shall be accompanied by accompanying documents, which shall include supplier information, product information, reference to this document (GB/T 39859), date of manufacture or packaging date, and should also include:

a) Product quality guarantee: - Main performance and technical parameters of the product; -

Product features (including the features of manufacturing process and raw materials); - Responsibility for product quality; - Quality certification obtained by the product and various analysis and inspection results checked and printed by the technical supervision department of the supplier.

b) Product certification; - Inspection items and their results or inspection conclusions; - Batch or batch number; - Inspection date; - Inspector's signature or seal.

c) Inspection report during product quality control and inspection report of finished product;

d) Product instructions: correct handling, use, and storage methods;

8 Order form content

The order form for the products listed in this document shall contain the following:

a) product name;

b) product model;

d) packaging method;

e) special requirements, specified in this document, which shall be negotiated by both the supplier and the buyer;

f) reference to this document (GB/T 39859). A.2.2 Digital voltmeter It can measure the voltage of

0.01 mV ~ 100 mV; the measurement error is less than ±0.5%. The input impedance of the instrument shall be more than 3 orders of magnitude greater than the resistance of the sample. A.2.3 Probe It does not dissolve or react in the sample. It can be made of graphite, tungsten, molybdenum, etc. A.2.4 Conductivity cell In accordance with the structure in Figure A.1, the ratio of the cross-sectional area of the quartz container between the voltage probes to the length of the sample is not greater than

0.2 mm. A.2.5 Constant temperature bath Water bath or oil bath, where the temperature error at constant temperature should not exceed ±0.5 °C. A.2.6 Others Fixtures and spreaders for conductivity cells, probes. A.3 Test temperature In the range of 25 °C ~ 30 °C, not lower than the melting temperature of the sample, which shall be indicated in the test report. A.4 Test steps A.4.1 Set the temperature of the constant temperature bath to the test temperature; fix the conductivity cell in the constant temperature bath. A.4.2 Put the liquid metal sample into the conductivity cell; fix the four probes connected to the constant current power supply and the digital voltmeter at the preset positions according to Figure A.1. The height of the sample liquid level shall ensure that the tip of the probe is not less than