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# Coatings for Sintered Neodymium Iron Boron Permanent Magnets

烧结钕铁硼表面镀层

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**Standardization Administration of the People's Republic of China.**

# Table of Contents

# Coatings for Sintered Neodymium Iron Boron Permanent Magnets

## 1 Scope

This Standard specifies the code of single-layer coating and multi-layer composite coating, substrate requirements, pre-plating preparation and process flow, performance requirements, test methods, inspection rules and markings, packaging, transportation, storage and quality certificates for the surface of sintered neodymium iron boron permanent magnet materials.

This Standard applies to protective and decorative coatings on the surface of sintered neodymium iron boron permanent magnet materials, including coatings (hereinafter referred to as coating products) using electroplating, electroless plating and physical vapor deposition technology.

## 2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in 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 Document.

GB/T 2423.1 Environmental testing for electric and electronic products - Part 2: Test methods - Tests A: Cold Delivery

GB/T 2423.8 Environmental testing for electric and electronic products - Parts 2: Test methods - Test Ed: Free fall

GB/T 2423.17 Environmental testing for electric and electronic products - Part 2: Test method - Test Ka: Salt mist

GB/T 2423.22-2012 Environmental testing - Part 2: Test methods - Test N: Change of temperature.

GB/T 2423.50 Environmental testing - Part 2: Test methods - Test Cy: Damp heat, steady state, accelerated test primarily intended for components

GB/T 3138 Metallic and other inorganic coatings - Surface treatment, metallic and other inorganic coatings - Vocabulary

GB/T 4955 Metallic coatings - Measurement of coating thickness - Coulometric method by anodic dissolution"

GB/T 5210 Paints and varnishes - Pull-off test for adhesion

GB/T 5270 Metallic coatings on metallic substrates - Electrodeposited and chemically deposited coatings - Review of adhesion strength test methods

GB/T 6462 Metallic and oxide coatings - Measurement of coating thickness - Microscopical method

GB/T 12334 Metallic and other inorganic coatings - Definitions and conventions concerning the measurement of thickness

GB/T 13560 Sintered neodymium iron boron permanent magnets

GB/T 16921 Metallic coatings. Measurement of coating thickness. X-ray spectrometric methods

QB/T 3814 Surface examination method of the metal deposits and conversion coatings for light industrial products

# 3 Terms and Definitions

For the purposes of this Document, the terms and definitions given in GB/T 3138 and GB/T 12334, and the following apply.

**3.1 Substrate**

The substrate referred to in this Document refers to the workpiece that requires surface treatment.

**3.2 Electroplating**

In order to obtain properties or dimensions that the substrate does not have, a metal or alloy layer with good bonding strength is deposited on the substrate by electrolysis.

**3.3 Barrel electroplating**

An electroplating process in which bulk workpieces are electrodeposited in a rotating, oscillating or otherwise moving container.

**3.4 Vat plating (GB) or still plating (US)**

Electroplating in which the parts to be plated are independently connected to the rack.

**3.5 Electroless plating or actocalytic plating**

**5.2** The surface-treated workpiece can be of various shapes, and its dimensional deviation, shape and position deviation, surface condition, etc. shall be accepted. The acceptance requirements for workpieces with special shapes and large dimensional differences in different directions shall be determined by negotiation between the supplier and the purchaser.

**5.3** The size of the residual magnetism of the workpiece shall affect the quality of the coating, and the supplier and the purchaser shall agree in advance before the plating process.

**5.4** Chamfering should be performed before plating; and the radius of curvature after chamfering is 0.1 mm~0.8 mm. There shall be no excessive chipping, scratches and abrasion after chamfering.

**5.5** Before plating, the workpiece shall be degreased and cleaned as required.

**5.6** Electroplating, electroless plating and physical vapor deposition techniques are usually used to coat the protective and decorative coatings on the surface of sintered NdFeB permanent magnet materials. For process guidelines, see Appendixes A, B and C, respectively.

# 6 Performance Requirements

### 6.1 Appearance quality

**6.1.1** The coating surface shall be free of rust spots, yellow marks, water stains and other bad marks. The passivation film on the coating surface shall be complete and there shall not be adhered whitening. On the main surface of the workpiece, there shall be no obvious coating defects, such as blistering, pores, corner burrs, coating cracks or local coating absence and coating shedding, etc., which are visible to the naked eye.

**6.1.2** During vat plating, 2 to 4 visible and unavoidable conductive contact marks of the hanger are allowed on the non-main surface; but this contact mark shall not expose the substrate and does not affect the overall protective performance of the product.

### 6.2 Thickness

The coating in the center area of the outer surface of the sintered NdFeB sample is relatively uniform. Under typical use environment conditions, the typical thickness range of various coatings in this area is shown in Table 4. The coating thickness is the guarantee of providing sufficient corrosion resistance. As the severity of the use environment increases, the coating thickness shall also increase accordingly.

The coating appearance inspection of the coated product shall be carried out in accordance with the provisions of QB/T 3814.

### 7.2 Thickness

The coating thickness is usually measured in accordance with the provisions of GB/T 16921. When the coating thickness exceeds the detection range, it shall be carried out in accordance with the provisions of GB/T 4955. In case of dispute, the provisions of GB/T 6462 may be adopted. For the measurement of the coating thickness, it is usually recommended to select 3 to 5 points within the $\phi$5 mm area of the center of the largest plane of the outer surface of the sample, and then take the average value as the measurement result. The maximum allowable deviation of the total coating thickness measurement is ±2 μm or the measured value × 15%, whichever is greater.

### 7.3 Corrosion resistance test

#### 7.3.1 Neutral salt spray test

The neutral salt spray test of the coating is carried out in accordance with the provisions of GB/T 2423.17. The continuous spray test method is adopted. The test conditions are: 35℃ ± 2℃, 5%±1% NaCl solution (mass fraction), and the pH of the collected salt spray precipitation solution is between 6.5 and 7.2. The specimen placement angle affects the test results. The inclination angle of the specimen surface in the salt spray chamber is 45°±5°.

#### 7.3.2 Damp heat test

The test shall be performed in accordance with the provisions of GB/T 2423.50. The test conditions are: temperature 85 ℃ ±2 ℃, relative humidity 85%±5%.

#### 7.3.3 Low temperature test

The test shall be performed in accordance with the provisions of GB/T 2423.1.

#### 7.3.4 High pressure accelerated aging test

Put the specimen into a high pressure accelerated aging test device containing distilled water or deionized water with a resistivity greater than 1.0 MΩ·cm. The test conditions for the unsaturated mode are: temperature 120 ℃ ±2 ℃, air pressure 0.2 MPa, and relative humidity controlled within the range of $100^{0}_{-5}$%; the test conditions for the more stringent saturated mode are: temperature 120 ℃ ±2 ℃, air pressure 0.2 MPa, and relative humidity 100%.

### 7.4 Adhering strength test

#### 7.4.1 Tensile test method

The test shall be performed in accordance with the provisions of GB/T 5210. The tensile test method can quantitatively give the adhering strength value between the coating and the

substrate, which must be greater than the value agreed upon by the supplier and the purchaser.

#### 7.4.2 Cross-cut method

The test shall be performed in accordance with the provisions of GB/T 5270.

#### 7.4.3 Thermal shock test method

The adhering strength of nickel coating, nickel-copper-nickel coating and composite coating with them as the bottom layer shall be tested according to the thermal shock test method specified in GB/T 5270, heating to 250 ℃, keeping warm for 1 h, and cooling in water no higher than 25 ℃.

#### 7.4.4 High and low temperature impact test method

The test shall be performed according to the temperature change test Na specified in GB/T 2423.22-2012.

#### 7.4.5 Drop test method

The test shall be performed according to the provisions of GB/T 2423.8.

## 8 Inspection Rules

### 8.1 Inspection and acceptance

**8.1.1** The coating products shall be inspected by the supplier's quality inspection department to ensure that the products meet the requirements of this Standard.

**8.1.2** The purchaser shall inspect the received products according to the provisions of this Standard. If the inspection results are inconsistent with the provisions of this Standard, they shall be raised within 1 month from the date of receipt of the product and resolved through negotiation between the supplier and the purchaser. If arbitration is required, the supplier shall jointly take samples and entrust an inspection agency recognized by both parties to conduct inspections.

### 8.2 Batching

Each batch of coated products shall be composed of the same production process and the same specifications.

### 8.3 Inspection items

Each batch of coated products shall be subject to type inspection items such as appearance quality, coating thickness, corrosion resistance and adhering strength.

### 8.4 Sampling

be unqualified.

# 9 Marking, Packaging, Transportation, Storage and Quality Certificate

### 9.1 Marking

The coated products that pass the inspection shall have labels with the following contents:

a) Supplier name and address;

b) Stamp from the supplier's quality inspection department;

c) Supplier's inspection date.

### 9.2 Packaging

Coated products shall be packaged with clean soft materials and properly stored. The packaging material shall not affect the performance of the coating.

### 9.3 Transportation and storage

Coated products shall be handled with care during transportation; stored in a dry environment away from corrosion; the storage environment shall also be moisture-proof, away from heat sources, strong magnetic fields, and avoid direct sunlight exposure.

### 9.4 Quality certificate

Each batch of coated products shall be accompanied by a quality certificate, indicating:

a) Supplier name;

b) Coated product name;

c) Batch number, number of pieces;

d) Results of various analysis and inspections and stamp from quality inspection department;

e) This standard number;

f) Inspection date;

g) Exit-factory date.

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