CCS H 16

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

GB/T 3488.3-2021

Hardmetals - Metallographic determination of microstructure - Part 3: Measurement of microstructural features in Ti (C, N) and WC/cubic carbide based hardmetals

Issued on: March 9, 2021 **Implemented on: October 1, 2021**

Issued by: State Administration for Market Regulation, China National Standardization Administration

Table of Contents

1 Scope

This document specifies the use of optical or electron microscopy to determine Ti(C,N)-based cemented carbide and other cubic carbide phases.

Metallographic determination method for the microstructure of WC/Co cemented carbide.

This document applies to sintered cemented carbide (sintered carbide cemented carbide or cermet), the main hard phase of this alloy is no Organic carbides and nitrides. This document is also applicable to tests that use the intercept method to determine the phase size and distribution.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. Among them, dated quotations Only the version corresponding to that date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to This document.

GB/T 3488.1-2014 Metallographic determination of the microstructure of cemented carbide Part 1.Metallographic photographs and description (ISO 4499-1.

2008, IDT)

GB/T 3488.2-2018 Metallographic determination of the microstructure of cemented carbide Part 2.Measurement of WC grain size (ISO 4499-2.2008, IDT)

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Nano grain nano The size of a single carbonitride or cubic carbide phase is less than 0.2 um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.2 Ultrafine The size of a single carbonitride or cubic carbide phase is 0.2um~0.5um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.3 Submicron The size of a single carbonitride or cubic carbide phase is 0.5um~0.8um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.4 Fine The size of a single carbonitride or cubic carbide phase is 0.8um~1.3um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.5 Medium grain The size of a single carbonitride or cubic carbide phase is 1.3um~2.5um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.6 Coarse grain The size of a single carbonitride or cubic carbide phase is 2.5um~6.0um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.7 Extracoarse The size of a single carbonitride or cubic carbide phase is greater than 6.0 um.

Note. Use the average intercept method described in GB/T 3488.2-2018 to measure.

3.8 Ti(C,N) cermets Ti(C,N)cermets Ti (C, N) cermets contain 3% to 30% of the mass fraction of the binder phase metal, mainly Co and/or Ni, sometimes containing There is Mo.

Note 1.The rest is a large amount of hard phase and a small amount of impurities.

Note 2.The hard phase is mainly titanium carbide, titanium nitride and/or titanium carbonitride, and may also contain (Ti, Ta), (Ti, W) or (Ti, Ta, W) carbonitrides.

Note 3.This type of material usually contains a hard phase of core/ring structure grains.

3.9 WC cubic carbide WC/cubiccarbidehardmetals Hexagonal WC-based cemented carbides containing a certain amount of cubic phase carbides, such as TiC or TaC. Such cubic phase carbides can be combined with W Form a solid solution.

Note 1.These materials usually contain a hard phase of core/ring structure grains.

Note 2.See Table 1.

3.10 Phaseregion The components in cemented carbide, such as WC, cubic carbide, and binder metal.

4 Symbols and units

The following symbols apply to this document.

A area, square millimeter (mm2)

ECD equivalent circle diameter of the measured phase, micrometer (um)

L Total length of the cut line of the measured phase, millimeter (mm)

li The measured length of a single line segment in the measured phase, micrometers (um)

sum li The sum of the measured lengths of a single section lx The arithmetic mean of the length measured by the intercept method in the x phase, micrometer (um)

The number of N straight line crossing the grain boundary of the phase to be measured n The number of intercepted WC, carbonitride or cubic carbide grains m magnification mmax maximum magnification mmin minimum magnification

5 Principle

This document gives the best method to measure the average size of the hard phase and binder phase in non-WC/Co cemented carbides. Recommended in this document Use the cut-line method to obtain the grain size data. The method described in GB/T 3488.1-2014 should be used to process metallographic samples.

Metallographic sample preparation and corrosion methods are as important as phase size measurement methods (see ASTM B657, ASTM B665, References [1] And [2]). For the basic method, see GB/T 3488.1-2014.See Chapter 8 for further information. The main types of carbides that are usually considered There are two types of types. cemented carbide containing cubic carbides and WC, TiC or Ti(C,N) cermets (references [3], [4], [5]).

The cubic carbide phase refers to the carbide with cubic lattice, such as TiC, TaC, this type of phase will contain W in the form of solid solution after sintering. This These materials usually contain a hard phase of core/ring structure grains. The guidance method for determining internal structure information refers to GB/T 3488.2-2018

Appendix A.

The most direct method to measure the phase size is to polish the cross-section of the microstructure to be tested and corrode it with an etching solution, and then use the area calculation method or cross-section Method and other quantitative metallographic detection methods to measure the average value of the phase size.

There are three ways to define the average size by the number of different phases.

---Length (the length of the cross-section through the two-dimensional cross-section of the phase);

---Area (the area of the two-dimensional cross-section of the phase region);

---Volume (single phase area).

The sum of the measured parameters (length, area, volume) is divided by the number of parameters to get the average value of the corresponding parameters.

The phase size is usually calculated by length. It can be calculated in the following ways.

---Measured by parallel lines or circles, the detailed method refers to ASTME112;

---Calculated by measuring the length of the section line across the structure to be tested, this method is the section line method, also known as the Heyn method;

---By calculating the circle equivalent diameter, first measure the area of the hard phase crystal grains, and then calculate the diameter of the circle with the same area, detailed See GB/T 3488.2-2018 for the method.

6 Equipment

6.1 Optical metallographic microscope, or other optical instruments with sufficient magnification to observe and measure.

6.2 Scanning electron microscope (SEM) can observe and measure the characteristic phases that are too small to be measured by optical microscopes.

6.3 Sample preparation equipment

The phase size is measured by the microstructure photograph. In order to obtain the best microstructure photo of the prepared sample cross section, you can refer to Methods in GB/T 3488.1-2014, ASTMB657 and ASTMB665.

An optical microscope or a scanning electron microscope (SEM) is usually used to take photos of the microstructure. For accurate measurement, choose scan The electron microscope is better. Even in samples with coarse grain materials, in the cross-sectional photos, the cut line will pass through the corners of the grains, resulting in very short The cut-line segments can only be accurately measured with SEM.

In the captured photos, the measurement of the length of the cut-off line can be achieved by manual or semi-automatic image analysis. Automatic image analysis technology It can be used in relatively coarse and distinct environments. But for many materials, especially for very fine grains, the effect is good The photos are difficult to obtain and it is not appropriate to use automatic image analysis methods.

For ultra-fine grains and nano grains, ordinary scanning electron microscopes that use tungsten wires as electron sources are difficult to take good photos.

sheet. To measure these materials, a field emission scanning electron microscope is required. With this system, higher resolution photos can be taken.