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GB/T 31309-2020

Calculation of electron vacancy number in cast superalloys

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Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard replaces GB/T 31309-2014 "Calculation Method of Electronic Vacancy Number of Nickel-based Superalloy", which is in line with GB/T 31309-2014

The main technical changes are as follows.

--- Added the calculation method of electron vacancy for cobalt-based cast superalloys (see 2.2, 2.4, 3.2 and 4.2.2);

--- Modified the calculation method of electronic vacancies for nickel-based cast superalloys (see 2.2, 2.3 and 4.2.1, Chapter 2 of.2014 edition and

4.2);

--- Removed the copper element in the electron vacancy matrix, added the ruthenium element, and modified the electron vacancy of the nickel element (see Table 1,.2014)

Version of Table 1);

--- Increased the calculation and application examples of the electron vacancy of typical superalloys (see Appendix B).

This standard was proposed by China Iron and Steel Association.

This standard is under the jurisdiction of the National Steel Standardization Technical Committee (SAC/TC183).

This standard was drafted by. Beijing Steel Research Gaona Technology Co., Ltd., Iron and Steel Research Institute, Metallurgical Industry Information Standards Institute, China

Hangfa Beijing Institute of Aeronautical Materials, China Aviation Development South Industries Co., Ltd., China Aviation Development Shenyang Liming Aero Engine Co., Ltd.

1 Scope

This standard specifies the calculation principle, calculation procedure, calculation method

and result application of the electronic vacancies of cast superalloys.

This standard is applicable to the calculation of the electronic vacancies in casting superalloy master alloys and castings.

2 Calculation principle

2.1 There are many types of strengthening elements in casting superalloys, and the saturation of each alloy element is high, which is easy to precipitate and have an adverse effect on strength and plasticity.

TCP phase, which mainly includes sigma, μ and Laves are equal. The precipitation law of these phases and the d-layer electron orbital of alloying elements in alloy gamma solid solution

The degree of the underfill of the Dao is related to the number of electrons. The electron vacancy Nv value of the alloy is calculated using equation (1).

Nv=sum

mi(Nv)i (1)

In the formula.

Nv --- Electronic gaps in alloys;

mi --- the atomic fraction of the ith element of the gamma solid solution in the alloy;

(Nv)i---the electronic gap of the i-th element;

n ---The number of elements in alloy gamma solid solution.

2.2 When calculating the electron vacancies, the precipitation phase in the alloy should be understood. The precipitation phase of nickel-based cast superalloys includes boride, carbide and

gamma'phase, cobalt-based casting superalloy precipitation phase includes boride and carbide. After deducting the alloy elements occupied by these precipitation phases, determine

gamma solid solution composition, and then calculate the electron vacancy.

2.3 The calculation principle of the electronic vacancies of nickel-based cast superalloys is as follows.

a) Nickel, chromium, titanium and molybdenum form (Mo0.5, Ti0.15, Cr0.25, Ni0.10) 3B2 boride, thereby obtaining the remaining elements after boride precipitation

???. The content.

b) The main carbide types in nickel-based alloys are MC, M23C6 and M6C. Assuming that

1/2C forms MC ie (Hf, Ta, Nb, Ti,

Zr,V)C,1/2C form M23C6, that is Cr21(Mo,W)2C6[(W Mo)<=6%], or M6C that is NiCo2(Mo,

W)3C [when (W Mo) >6%], the residual content of the elements after carbide precipitation is obtained.

c) The remaining aluminum, titanium, hafnium, niobium, tantalum, 50% of the original content of vanadium and 3% of the original content of chromium form a gamma'phase with 3 times the nickel, which is Ni3

(Al, Ti, Nb, Hf, Ta, 0.5V, 0.03Cr), the remaining solid solution components after precipitation of carbide, boride and gamma'phase are obtained.

d) Use formula (1) to calculate the average electron vacancy Nv of the remaining solid solution.

2.4 The calculation principle of the electronic vacancies of cobalt-based cast superalloys is as follows.

a) Nickel, chromium, titanium and molybdenum form (Mo0.5, Ti0.15, Cr0.25, Ni0.10) 3B2 boride, thereby obtaining the remaining elements after boride precipitation

???. The content.

b) The main carbide types in cobalt-based alloys are MC, M23C6 and M6C. Assuming that 1/2C forms MC ie (Hf, Ta, Nb, Ti,

Zr,V)C,1/2C form M23C6, that is Cr21(Mo,W)2C6[(W Mo)<=6%], or M6C that is NiCo2(Mo,

W)3C [when (W Mo) >6%], the residual content of the elements after carbide precipitation is obtained.

c) Calculate the average electron vacancy Nv of the remaining solid solution using equation (1).