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Methods for determination of banded structure of steels

钢中带状组织的评定方法

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Foreword

This document was drafted in accordance with the provisions of GB/T 1.1-2020 "Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents".

This document replaces GB/T 34474.1-2017 "Determination of banded structure of steel - Part 1: Micrographic method using standards diagrams" and GB/T 34474.2-2018 "Determination of banded structure of steel - Part 2: Quantitative method". Compared with GB/T 34474.1-2017, the main technical changes, besides structural adjustments and

editorial modifications, are as follows.

- a) ADD a hardness test (see 7.3, 8.1, 8.2.3, 9.4);
- b) ADD a special test method for banded structure in service condition (see 9.2.8);
- c) ADD a special test method for extremely narrow banded structure (see 9.2.9);
- d) ADD the isothermal annealing heat treatment for specimens (see 8.1);
- e) ADD calculation methods for anisotropy index AI and orientation degree ohm12 (see 9.3.2.2.8, 9.3.2.2.9);
- f) ADD the determination of the band ratio BR parameter (see 9.3.2.2.11);
- g) ADD the calculation method for volume fraction VV (see 9.3.2.2.13);
- h) ADD the calculation method for shape ratio e (see 9.3.2.2.17);
- i) ADD the calculation method for the 95% uncertainty of the parameters anisotropy index AI, orientation degree ohm12, band ratio BR (see Appendix B);
- j) ADD the simplified algorithms for the anisotropy index AI, orientation degree ohm12, band ratio BR parameters (see Appendix C).

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed by the China Iron and Steel Association.

This document shall be under the jurisdiction of the National Steel Standardization Technical Committee (SAC/TC 183).

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Methods for determination of banded structure of steels

1 Scope

This document describes three methods for evaluating banded structures in steel. the standard rating chart method, the quantitative method, the hardness method. It includes an overview of the methods, equipment, sampling, specimen preparation, evaluation methods, test results, test reports.

This document applies to the inspection and evaluation of banded structures in steel that has undergone plastic deformation.

2 Normative references

GB/T 225

GB/T 4340.1

GB/T 13298

GB/T 15749

GB/T 18449.1

GB/T 30067

GB/T 33362-2016

3 Terms and definitions

The terms and definitions defined in GB/T 30067, as well as the following terms and definitions, apply to this document.

3.1 Banded structure

Alternating bands of structure parallel to the processing direction, formed by the deformation and elongation of segregation zones during processing.

3.2 Class II structure banding

Bands consisting of structures other than ferrite, including pearlite, bainite, martensite, and other non-equilibrium structures, either singly or mixed together.

Note. In the standard rating chart method, Class II structure banding is rated as a whole as a structure category.

3.3 Continuous banding

Bands of the same structure existing in the evaluation field of view, where grains within the band are separated only by grain boundaries and no other structure types are present.

4 Symbols

The following symbols and explanations apply to this document (see Table 1).

Table 1 -- Symbols and explanations

5 Method overview

This document specifies three methods for evaluating banded structures in steel.

standard rating chart method, quantitative method, hardness method.

- Standard rating chart method. Compare the observed field of view with a standard rating chart and select the most severe field of view for rating. Applicable to the evaluation of banded structures (ferrite bands and class II structure bands) in hypoeutectoid steel.
- Quantitative method. Count the number of intercepts or points parallel to and perpendicular to the principal deformation direction, or measure the intercepts, calculate characteristic parameters to characterize the orientation and uniformity of the microstructure. Applicable to the evaluation of banded structures in all oriented steels, such as ferrite bands, pearlite bands, bainite bands, martensite bands, austenite bands, carbide bands. Includes a description of the banded structure, as well as the determination of parameters such as anisotropy index, orientation degree, band ratio, band spacing, path of freedom, band width.
- Hardness method. Determines the hardness of martensite and bainite bands, or color difference bands, on and between bands in a hardened specimen. The difference characterizes the degree of compositional segregation or property differences. Applicable to the evaluation of banded structures in quenchable steels.

Note. For quenched, fully martensitic hypoeutectoid carbon and alloy steels, the carbon content in the matrix and segregated areas is estimated from the hardness value, indicating the degree of carbon segregation.

6.1 Optical microscope. Preferably equipped with relevant image acquisition and analysis software system, eyepiece with scale and measuring grid.

6.2 Vickers hardness tester or Knoop hardness tester. Equipped with a device capable

of measuring microhardness. Hardness testers require periodic calibration; standard hardness blocks must be calibrated according to metrological requirements.

7 Sampling

7.1 Generally, specimens shall be taken from the product in its delivered condition.

7.2 The inspection surface shall be parallel to the main deformation direction of the steel. Sampling methods shall be as specified in the product standard or technical specifications. If not specified, it is recommended that the specimen be centered at the steel's centerline or at 1/4 of its diameter (side length, width), with a size of 20 mm x 10 mm (see Table 2 and Figures 1 ~ 3).

7.3 For the hardness test, end-quenched specimens are preferred. A 10 mm