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Non-destructive Testing - Method for Thermoelectric Sorting of Electrically Conductive Materials

无损检测 导电材料热电势分选方法

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1 Scope

This Standard specifies the techniques and methods for material sorting of conductive materials using direct and comparative thermoelectric potential sorters based on the Seebeck effect.

This Standard is applicable to the sorting of metal materials, the piece-by-piece manual sorting of metal workpieces and automatic sorting of large quantities of metal workpieces. The identification and sorting of metal plating thickness, hardness and hardened layer depth may take this Standard as a reference.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 20737 Non-destructive Testing - General Terms and Definitions

3 Terms and Definitions

What is defined in GB/T 20737, and the following terms and definitions are applicable to this document.

3.1 Seebeck Effect

Seebeck effect refers to a phenomenon, in which, an electromotive force is generated in a loop composed of two conductors when the two contact points of the two conductors are at different temperatures.

3.2 Comparative Instrumentation

Comparative instrumentation refers to an instrument which is composed of electrode components (probes) and related electronic circuits. It compares the thermoelectric potential value of a certain conductive material with the thermoelectric potential value of a standard test piece to perform material sorting.

method and comparative sorting method. In the direct instrumentation, the data of standard test pieces with already-known chemical composition and thermal treatment state is built into the detection system in a standardized mode, and the instrument directly displays the thermoelectric potential value of the metal being tested. In the comparative instrumentation, it is necessary to compare the thermoelectric potential value of the tested metal obtained through the test with the thermoelectric potential value of one or more already-known standard test pieces, and judge whether it is within the acceptability limit of a certain type of material.

Both the sorting methods need to be compared with the already-known standard test pieces. In order to set the acceptability limit, two or more standard test pieces are needed for calibration.

5.2 Direct Sorting

When the method of direct sorting is used, firstly, a standard test piece with already-known material is put in contact with an electrode of a set temperature to form a closed circuit; the direct instrumentation is adjusted to obtain a thermoelectric potential value. Then, the electrode is put in contact with the metal to be sorted to measure its thermoelectric potential value.

5.3 Comparative Sorting

When the method of comparative sorting is used, firstly, several standard test pieces representing the acceptability limit (allowable limit) of a certain type of material are respectively put in contact with the electrode to form a closed circuit; the parameters of the comparative instrumentation are adjusted, so that the thermoelectric potential values of several standard test pieces are in an appropriate section of the indication range of the instrumentation. Then, put the electrode in contact with the metal to be sorted; observe the response of the comparative instrumentation; judge whether the thermoelectric potential value of the metal is within the acceptability limit.

For sorting with high distinguishing requirements, the comparative sorting method should be adopted. The advantage of the comparative sorting method is that it can suppress the internal and external interference from the comparative instrumentation, for example, the temperature change of the tested metal or electrode.

6 Sorting Conditions

6.1 Overview

Whether the thermoelectric potential sorter can successfully realize the sorting depends on the material of the electrodes, the temperature difference between the two electrodes, the contact state of the electrode and the metal, and the difference of the Seebeck effect of the different materials to be sorted. Good contact between the

7.2 Electrodes for Testing

The electrodes can be two or more independent electrodes, or a probe composed of multiple electrodes. The electrodes shall be able to simultaneously contact the same surface or different surfaces of the metal.

For manual sorting objects that are small in the testing area and difficult to achieve effective heating, such as: thin foils, wires and small bearings, etc., the objects may be fixed with clamps.

7.3 Automatic Sorting Equipment

The automatic sorting equipment used for the sorting of specific metal materials shall be equipped with mechanical devices for automatic material-loading and automatic sorting.

8 Sorting Procedures

8.1 Preparation of Standard Test Pieces

Select two or more test pieces with already-known materials, and test pieces whose material change can represent the material change of the material to be sorted as the standard test pieces. Thus, provide the sorter with the acceptability limit of thermoelectric potential for the material sorting.

8.2 Equipment Calibration

Each time the sorting equipment is re-used or when the metal type to be sorted is changed, the standard test pieces shall be used to calibrate the equipment.

The calibration steps of the equipment shall be carried out in accordance with the requirements of the instruction manual of the thermoelectric potential sorter.

During the calibration process, when adjusting the instrument parameters, it shall be ensured that the value displayed by the instrument represents the thermoelectric potential value of the standard test piece and is within the indication range of the instrumentation. In addition, it shall also be ensured that the deviation generated by the standard test pieces is within the allowable range, in which, the metal to be tested is distinguishable.

8.3 Sorting and Testing

Sorting and testing can be performed after the equipment is qualified in the calibration. The sorting shall be performed one by one or batch by batch.

During the sorting and testing, the signal displayed by the instrument shall be observed

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