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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 21227-2021

AC loss measurements - Magnetometer methods for hysteresis loss in superconducting multifilamentary composites

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part 1.Structure and Drafting Rules of Standardization Documents"

Drafting.

This document replaces GB/T 21227-2007 "AC loss measurement Cu/Nb-Ti multi-filament composite wire hysteresis loss magnetometer measurement

Law, compared with GB/T 21227-2007, in addition to structural adjustments and editorial changes, the main technical changes are as follows.

--- Modify the statistical terminology, use "uncertainty (uncertainty)" instead of "accuracy (accuracy)" (see Chapter 4, 6.3,

Chapter 4, 6.2 of the.2007 edition);

--- Added the extension of this measurement method to general superconductors and measurement temperatures other than 4.2K (see Appendix B);

--- Increased uncertainty considerations (see Appendix C).

This document uses the translation method equivalent to the IEC 61788-13.2012 "Superconductivity Part 13.AC loss measurement multi-filament composite

Magnetometer measurement method for hysteresis loss of superconducting materials.

The Chinese documents that have consistent correspondence with the normatively cited international documents in this document are as follows.

---GB/T 2900.100-2017 Electrotechnical term superconductivity (IEC 60050-815.2015, IDT);

---GB/T 22587-2017 Measurement of the volume ratio between the substrate and the superconductor.

Product] ratio measurement (IEC 617885-5.2013, IDT).

This document has made the following editorial changes.

---In order to be consistent with the existing standard series, the file name is revised to "AC loss measurement of multi-filament composite superconducting material hysteresis loss

Magnetometer measurement method;

--- The content in C.5 is included in the reference and renumbered, and its quotation in the text has also been adjusted according to the new number.

Introduction

At the beginning of the standardization of measurement methods for the contributions of various parts of the AC loss in the transverse magnetic field (the most common case), the International Electrotechnical Commission

The Superconducting Technical Committee (IEC /TC90) proposed to measure the copper-niobium-titanium (Cu/Nb-Ti) composite superconducting wire with the

magnetometer method and the detection coil method

AC loss in a transverse magnetic field that varies with time.

After discussion, it was decided to split the above proposal into two documents, covering two standard methods respectively. One of them is used to describe hysteresis loss and

Magnetometer measurement method of total AC loss under low frequency magnetic field (or low sweep field rate); the other is used to describe the higher frequency magnetic field (or higher sweep field

Rate) of the total AC loss under the detection coil measurement method. The measuring frequency range of the magnetometer method is 0Hz~0.06Hz, and the detection coil method is

0.005Hz~60Hz. The overlapping part (0.005Hz~0.06Hz) is the frequency range in which both methods can be used.

This document refers to the magnetometer measurement method.

AC loss measurement multi-filament composite superconducting material

Magnetometer measurement method of hysteresis loss

1 Scope

This document describes the use of DC or low-sweep field rate magnetometer methods to measure the hysteresis loss of Cu/Nb-Ti multifilament composites.

should. This document specifies a method for measuring hysteresis loss in Cu/Nb-Ti multi-filament composite conductors. Measured at a temperature of 4.2K or close

Performed on 4.2K circular cross-section superconducting wire. The DC or low-sweep field rate magnetometer method uses a superconducting quantum interference device (SQUID)

Magnetometer (see Appendix A) or Vibrating Sample Magnetometer (VSM). If it is found in the measurement that a different (but all calibrated) magnetometer is used

If there is a difference between the results, the VSM measurement results extrapolated to zero sweep field rate shall prevail. Extend this measurement method to general superconductors

The specifications are detailed in Appendix B.

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.

IEC 60050 (all parts) International electrotechnical vocabulary (see \u003chttp.//

IEC 61788-5 Superconductivity Part 5.Measurement of the volume ratio of substrate to superconductor Copper-niobium-titanium (Cu/Nb-Ti) composite superconducting wire

Copper-superconductor volume ratio measurement (Superconductivity-Part 5.Matrix to superconductor volume ratio

measurement-CoppertosuperconductorvolumeratiofCu/Nb-Ticompositesuperconductors)

3 Terms and definitions

The following terms and definitions defined by IEC 60050-815 apply to this document.

3.1

AC loss ACloss

The power lost in the composite superconductor due to the time-varying magnetic field or current.

Note. The AC loss in each magnetic field (change) period is marked as Q. Although in general, all such losses inevitably have "hysteresis", but complex

The AC loss in superconducting materials can usually be divided into hysteresis loss, eddy current loss and coupling loss (see IEC 60050-815.2015 815-13-52

Note 1 and Note 2), respectively, are defined as follows.

[Source. IEC 60050-815.2015, 815-13-52, with modification]

3.2

Hysteresis loss

Ph

A loss of superconductor in a changing magnetic field, its value is proportional to the frequency of the alternating magnetic field.

Note 1.The hysteresis loss is caused by the irreversible magnetism of the superconducting material caused by magnetic flux pinning.

Note 2.Hysteresis loss only occurs in the superconducting region of the Cu/Nb-Ti composite material, so there will be hysteresis loss even if there is no matrix material. each