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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 39843-2021

Electronic characteristic measurements - Local critical current density and its distribution in large-area superconducting films

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Foreword

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

The translation method used in this standard is equivalent to the use of IEC 61788-17.2013 "Superconductivity Part 17.Measurement of electronic characteristics for large areas

The local critical current density and its distribution of superconducting films.

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

---GB/T 2900.100-2017 Superconductivity in electrical engineering terms (IEC 60050-815.2015, IDT).

This standard has made the following editorial changes.

---Modified the standard name;

---A.8, B.3, C.5, and D.7 of IEC 61788-17.2013 are included in the references, and their citations in the text have been adjusted accordingly;

---The edition cited in terms and definitions in IEC 61788-17.2013 has been changed, and the

Some) amended to IEC 60050-815;

---Modified the editorial errors in the individual clauses of IEC 61788-17.2013.

This standard was proposed by the Chinese Academy of Sciences.

This standard is under the jurisdiction of the National Superconducting Standardization Technical Committee (SAC/TC265).

Drafting organizations of this standard. Shanghai University, University of Electronic Science and Technology of China, Shanghai Shangchuang Superconducting Technology Co., Ltd., Institute of Physics, Chinese Academy of Sciences.

Introduction

In the more than 30 years since its discovery in 1986, high-temperature superconductors have been used in many products and technologies, which will cause information transmission,

Changes in the transportation and energy sectors. Among them, high-temperature superconducting (HTS) microwave filters that take advantage of the extremely low surface resistance of superconductors have been

Commercialization. Compared with conventional filters, superconducting filters have two main advantages, namely. low insertion loss (low noise characteristics) and high frequency selection

Sex (steep sidebands) [1]. These advantages can reduce the number of base stations, improve call quality, use frequency bandwidth more effectively, and reduce unnecessary

Necessary radio wave noise.

Large-area superconducting films have been used in microwave devices[2], and also used in emerging superconducting power devices, such as resistive superconducting fault current limiters (SF-

CLs) [3-5], superconducting fault detection of triggered superconducting fault current limiter [6,7] and continuous current switching of closed-loop operation of high-temperature superconducting magnets [8,9].

The critical current density Jc is one of the key parameters describing the quality of large-area high-temperature superconducting films. The non-destructive AC induction method is widely used to measure large

The Jc of area high-temperature superconducting film and its distribution [10-13], the most common of which is the method of using the third harmonic voltage U3cos(3omegat theta), where

omega, t, and theta represent angular frequency, time, and initial phase, respectively. However, these traditional methods are not accurate because the Jc measurement is not taken into account.

The electric field intensity E criterion [14,15]. Jc is calculated from the current threshold Ith, and sometimes the electric field criterion used to determine Ith is not appropriate [16].

The Jc value obtained by the traditional method has an error of 10% to 20% compared with the accurate value [15]. Therefore, it is necessary to establish a standard test method to

To accurately measure the local critical current density and its distribution, all industries involving high-temperature superconducting filters can refer to this standard for high-temperature superconducting

Quality control of the guide film. The background knowledge of the induction method for measuring Jc of high-temperature superconducting films is summarized in Appendix A.

In these induction testing methods, an alternating current I0cosomegat is passed into a small coil directly above the superconducting film to generate an alternating magnetic field, which can be passed through.

Jc is calculated from the coil current threshold Ith when the magnetic field completely penetrates the superconducting film [17]. For the induction method using the third harmonic voltage U3, measure

U3 is a function of I0, and the current I0 in the coil when U3 starts to appear is defined as Ith. When I0=Ith, the superconducting film induced electric field intensity

E is proportional to the AC current frequency f and can be estimated by a simplified Bean model [14]. This standard proposes a method based on electric field strength

The degree criterion is to detect U3 and obtain the n-value (the power exponent of the EJ characteristic curve) through the Ith value accurately measured at different frequencies to achieve accurate Jc measurement.

The method of quantity [14,15,18,19]. This method not only can obtain an accurate Jc value, but also helps to find the degraded part of the non-uniform sample performance.

This is because the decrease of the n-value of the performance degradation part is more obvious than that of Jc [15]. Although the key parameter of microwave device design is surface resistance rather than

Jc, but it should be noted that this standard test method can evaluate the uniformity of large-area high-temperature superconducting film Jc well. Application to SFCLs

In general, it is important to know the distribution of Jc, because the distribution of Jc seriously affects the distribution of quench points when SFCLs fail.

The issuing organization of this document draws attention to the relevant content in the introduction, Chapter 1, Chapter 4 and 5.1 of this document when the declaration conforms to this document.

Involving the use of a patent, the technical content of the patent protection is the induction method to measure Jc and determine EJ characteristics at different frequencies.

The issuing agency of this document has no position on the authenticity, validity and scope of the patent.

The patent holder has assured the International Electrotechnical Commission (IEC) that he is willing to work with applicants all over the world on the patent license for free

negotiation. The statement of the patent holder has been filed with IEC. Relevant information can be obtained through the following contact methods.

Patent holder.

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Please note that in addition to the above-mentioned patents, certain contents of this document may still involve patents. The issuing agency of this document is not responsible for identifying these