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Practical superconducting wires - Twist pitch measurement method for Nb-Ti and Nb3Sn composite superconductors

实用超导线 铌-钛（Nb-Ti）与铌三锡（Nb3Sn）复合超导体的扭距测量方法

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Foreword

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The changing magnetic field will induce a coupling current in the multifilament composite superconductor. Body, forming a loop between the superconducting wires, resulting in coupling loss. The coupling loss and the rate of change of the magnetic field and the torque of the multi-filament composite superconductor are shut. The torsion process can effectively inhibit the coupling between superconducting wires and reduce the magnetic flux jump, so as to achieve the purpose of reducing loss and increasing stability. because Therefore, the torque is an important parameter of the composite superconductor, and it needs to be accurately measured after the production of the multi-filament composite superconductor. Different composite superconductors have different structures, and appropriate measurement methods, such as back-torsion method and metallographic method, need to be selected for the specific structure. This document uses the back-twist method to measure the torque of Nb-Ti and Nb3Sn composite superconductors. The issuing agency of this document draws attention to the fact that when declaring compliance with this document, the ZL201210278929.1 The use of patents related to the "Torque Device". The issuing agency of this document has no position on the authenticity, validity and scope of the patent. The patent holder has promised to the issuing organization of this document that he is willing to work with any applicant under reasonable and non-discriminatory terms and conditions. Negotiations on the licensing of patents. The statement of the patent holder has been filed with the issuing agency of this document. Relevant information can be through the following Contact information. Patent holder name. Gao Huixian Address. No. 12, Mingguang Road, Economic and Technological Development Zone, Xi'an City, Shaanxi Province 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 patents responsibility. Practical superconducting wire niobium-titanium (Nb-Ti) and niobium tin (Nb3Sn) Composite Superconductor Torque Measurement Method Important note. The application of this document may involve certain hazardous materials and operations. But not all the security issues related to this All make suggestions. Before using this document, the user is responsible for formulating corresponding safety and protection measures and clarifying its restricted scope of application.

1 Scope

China's national method for measuring the twist pitch of niobium-titanium and niobium-tin composite superconducting wires. It specifies the terms and definitions, the principle and the apparatus. A practical superconducting wire is not a single conductor but thousands of fine superconducting filaments embedded in a copper matrix, and those filaments are twisted along the length of the wire like the strands of a rope. The twist is not for mechanical reasons. In a changing magnetic field, untwisted parallel filaments are coupled by currents flowing through the matrix between them, and that coupling produces losses and can drive

the conductor normal - a quench. Twisting them at a short enough pitch breaks the coupling loops and suppresses the effect. The pitch is therefore a designed electrical parameter, and verifying it is part of accepting the wire that will be wound into an MRI magnet, an accelerator dipole or a fusion coil.

This document describes the principle of torque measurement of Nb-Ti and Nb3Sn composite superconductors, chemicals, equipment, sample preparation, and measurement Procedure, test data processing, measurement uncertainty and test report. This document is applicable to the diameter of 0.2mm~2mm (or the rectangle with the same cross-sectional area), the diameter of superconducting wire is 6μm~200μm, The torque is measured in the integrated structure of Nb-Ti and Nb3Sn multi-filament superconductors with a copper matrix of 5mm~50mm. This document does not apply to superconductors with a coating on the surface or a coating that cannot be eroded by nitric acid. Note

1.Using this method to measure the cross-sectional shape, area, superconducting wire diameter and torque of composite superconductors outside this range, the uncertainty will increase. Note

2.After appropriate amendments, the measurement method given in this document is applicable to other composite superconductors of similar structure.

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.

GB/T 2900.100-2017 Electrical terminology superconductivity

3 Terms and definitions

The following terms and definitions defined in GB/T 2900.100-2017 apply to this document.

3.1 Twist The rotation of a wire or strand in a composite conductor about the axis of the conductor. [Source: GB/T 2900.100-2017,815-13-46]

3.2 Twist direction The direction of the wire or strand when twisting.

Note. There are two types. left-handed and right-handed. Place the sample vertically, the same superconducting wire is twisted, the left side is high, the right side is low, it is left-handed, and the right side is high and the left is low is right-handed.

3.3 Twistpitchlength;twistpitch Lp In a twisted conductor, the axial length of the wire or strand returning to its initial radial position for the first time. [Source: GB/T 2900.100-2017,815-13-47]