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**Weak static magnetic field imaging method based on a
scanning nitrogen-vacancy probe**

基于扫描氮-空位探针的微弱静磁场成像测量方法

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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 for standardization documents" Drafting: Please note that some of the contents of this document may involve patents: The issuing organization of this document does not assume the responsibility for identifying patents: This document was proposed and coordinated by the National Technical Committee on Quantum Computing and Measurement Standardization (SAC/TC578): This document was drafted by: Guoyi Quantum Technology (Hefei) Co., Ltd., University of Science and Technology of China, Jinan Institute of Quantum Technology, Beijing University of Aeronautics and Astronautics, Shanghai Institute of University of Science and Technology of China, North University of China, Zhijiang Laboratory, Institute of Physics, Chinese Academy of Sciences, Beijing Great Wall Metrology and Testing Technology Institute of China Aviation Industry Corporation, Beijing China Airlines Radio Measurement Institute, and Nanjing University: The main drafters of this document are: Rong Xing, Wang Pengfei, Xu Kebiao, Huang Wenhao, Wang Minglei, Yuan Heng, Sun Qichao, Tang Jun, Xu Nanyang, Liu Gangqin, Wang Yu, Ma Jingting, Huang Pu, and He Yu: Weak static magnetic field based on scanning nitrogen-vacancy probe Imaging measurement method

1 Scope

China's national method for imaging weak static magnetic fields using a scanning nitrogen-vacancy probe. The nitrogen-vacancy centre is a point defect in diamond - a nitrogen atom beside a missing carbon - whose electron spin can be initialised and read optically at room temperature, and whose resonance frequency shifts with the local

magnetic field. Mounted at the tip of a scanning probe it becomes a magnetometer with a spatial resolution of tens of nanometres and a sensitivity that no other room-temperature technique approaches. What it enables is imaging magnetic structure at a scale relevant to the objects that matter: the domains in a recording medium, the current paths in an integrated circuit, the magnetic order in a two-dimensional material, and the fields of individual biological structures. Standardising the method matters because the measurement depends on the probe's calibration, its standoff and its orientation, none of which are self-evident.

This paper describes a method for imaging the weak static magnetic fields generated by a sample using scanning nitrogen-vacancy probe microscopy: This document is applicable to the use of scanning nitrogen-vacancy probe microscopy to perform magnetic induction intensity imaging on the sample surface. The specific scenarios are as follows:

- Magnetic analysis of weak magnetic samples (magnetic induction intensity typical value < 10mT) represented by magnetic films and two-dimensional magnetic materials Imaging;
- Magnetic imaging of magnetic samples with low coercivity;
- Quantitative study of magnetic structure or magnetic moment density;
- Imaging of microscopic scale electric current and magnetic field:

Note: The nitrogen-vacancy color centers referred to in this document refer specifically to the negatively charged nitrogen-vacancy color centers in diamond:

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document: For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This document:

GB/T 2900:60-2002 Electrical terminology - Electromagnetism

3 Terms and definitions

The terms and definitions defined in GB/T 2900:60-2002 and the following apply to this document: 3:

1 Nitrogen-vacancy (color) center A point defect in diamond is formed when a carbon atom is replaced by a nitrogen atom and there is a vacancy in the adjacent position:

Note: Hereinafter referred to as "NV color center": 3:

2 An instrument for scanning magnetic imaging of samples is realized by combining

nitrogen-vacancy color center (3:1) optical detection magnetic resonance technology and scanning probe microscopy technology: 3:3 scanning nitrogen-vacancy probe A probe containing a single nitrogen-vacancy color center (3:1) that enables scanning measurement capabilities: 3:

4 The number of fluorescence photons collected per unit time by the scanning nitrogen-vacancy probe microscope (3:2):

Note: The unit is negative first power second (s-1):