Contribution ID: **353**

Type: **Poster**

M2Po3B-03: Magnetoresistance analysis and calibration of zirconium oxynitride sensor for low-temperature thermometry

Tuesday 20 May 2025 14:00 (2 hours)

Accurate temperature measurement is essential for exploring material properties at low temperatures and in magnetic field environments. Resistance temperature thermometers are affected by magnetoresistance, which can cause measurement errors when calibrated solely in zero magnetic fields. Zirconium oxynitride thin films, renowned for their extremely low magnetoresistance, are widely used for low-temperature measurements in strong magnetic fields. In this study, a series of zirconium oxynitride thin films were prepared, and their zero-field resistance-temperature ($R(T)$) curves were measured across the range of 300 K to 2 K. Additionally, their field-dependent resistance ($R(B, T = \text{const})$) was evaluated in out-of-plane magnetic fields from 0 to 9 T at fixed temperatures between 2 K and 6 K. The samples exhibited diverse magnetoresistance behaviors—positive, negative, and saturated—highlighting complex nonlinear phenomena. The mechanisms underlying the positive and negative magnetoresistance were analyzed. For samples suitable for temperature measurements down to 2 K, a maximum temperature deviation of 0.48% was observed within the 9 T magnetic field range. The $R(T)$ relationship at zero magnetic field was established using Chebyshev polynomial fitting. Subsequently, magnetic field correction factors were introduced into the $R(T, B)$ relationships within the 2 K to 6 K range, enabling the development of a calibration procedure for low-temperature sensors operating in magnetic fields up to 9 T. This work aims to enhance the accuracy of low-temperature measurements in magnetic field environments through improvements in sensor design and calibration procedures, which are critical for applications in superconducting accelerators, power systems, and related fields.

Author: GENG, Zhen (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences)

Co-authors: HAN, Yemao (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences); MIAO, Zhicong; XIE, Liancheng; JIANG, Di; ZHANG, Hongwei (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences); ZHAO, Yuqiang; HUANG, Rongjin (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences); Prof. LI, Laifeng (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences)

Presenter: GENG, Zhen (Technical Institute of Physics and Chemistry, Chinese Academy of Sciences)

Session Classification: M2Po3B - Cryogenic Testing, Standards, Procedures, and Measurements