Contribution ID: **831** Type: **Poster**

Thu-Af-Po.12-03: Design and research of magnetic fluid rotary seal for high temperature superconducting motor

Thursday 3 July 2025 14:00 (2 hours)

High-temperature superconducting (HTS) motors have broad application prospects in fields such as energy and transportation due to their high efficiency and energy-saving characteristics. However, the vacuum and low-temperature conditions in their operating environment impose stringent requirements on sealing technology. This study addresses the sealing demands of HTS motors by designing a rotary sealing structure based on ferrofluid sealing. The structure ensures stable helium transmission with a low leakage rate and integrates with sliding brushes to facilitate power transmission. A theoretical model of ferrofluid sealing was established to analyze the effects of magnetic field strength, sealing gap, and ferrofluid properties on sealing performance. By combining numerical simulations with experimental validation, the sealing structure's parameters were optimized, and its performance and stability under various operating conditions were evaluated. The results indicate that the ferrofluid rotary seal exhibits excellent gas-tightness and durability, effectively meeting the operational requirements of HTS motors and providing technical support for their engineering applications.

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Session Classification: Thu-Af-Po.12 - Novel Devices