Development of Rotating Probe for Dilution Refrigerator

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Introduction

It is important to continue developing measurement platforms for top-loading systems at the NHMFL DC field facility in order to pursue cutting-edge experiments for users. In-situ rotating sample holder at low temperatures in magnetic fields is critical for a large number of measurements done at the MagLab. In particular, for measurement of angle dependent magnetoresistance, and phase transitions in crystalline materials.

Experimental

A rotating sample platform was designed for the dilution refrigerator in SCM1, using the same concept of the previous rotating probe in NHMFL. The base structure is constructed of titanium and stainless steel for strength, durability and minimization of eddy current heating at ultra-low temperatures. Titanium also reduces weight of the probe. Base temperature, heater response and angle control have been successfully tested.

Results and Discussion

Base temperature was below 17mK in SCM1 at zero field, and the temperature was controlled up to 1K using heater current setpoint of 5.5mA.The angle of the sample stage was defined and repeatable, based on the voltage of a Hall sensor. Rotations at base temperature did not produce heating in either the mixing chamber or at the sample position.

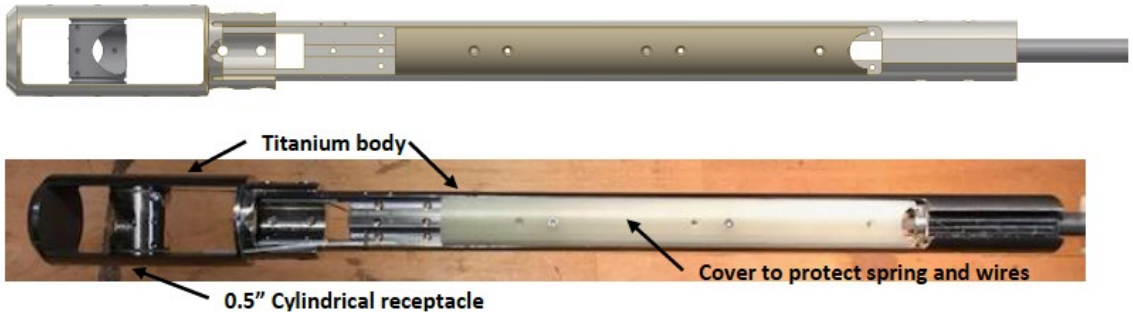

Fig.1 3D CAD drawing and picture of newly designed rotating probe.

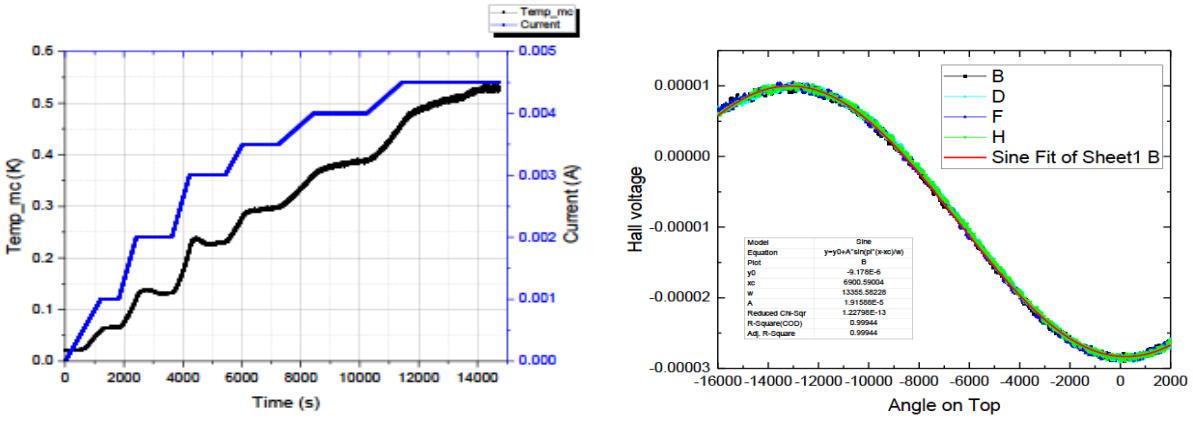

Fig.2 Temperature control on mixing chamber according to heater current and Hall voltage vs. angle of platform.

Conclusions

A rotating probe has successfully developed for dilution refrigerator in SCM1, which can be utilized in user programs at NHMFL DC facility.

Acknowledgements

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