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Thu-Af-Po.05-02: Optimized design of frequency characteristics of high-sensitivity inductive coil for magnetization measurements

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A high-sensitivity inductive coil for detecting the Haas-van Alphen oscillations of magnetic materials or calibrating magnetic field was fabricated. The coil contains part A and part B which are well compensated in applied external fields with opposite winding directions. Fabrication of a high density (>1000 turns) pick-up coil within a small sample space (diameter˜3mm) is challenging. Therefore, A higher degree of compensation, suitable sensitivity, and excellent high-frequency characteristics are key factors in the design of magnetization detection coils. However, the greater number of turns in the coil results greater inductance. When measuring high-frequency signals, the large inductance of the coil will resonate with the distributed capacitance of the measurement system, resulting in oscillations and phase lag in the measured magnetization signal.
In this study, the magnetization signal was superimposed by dividing the detection coil into different parts and collecting each part separately. Coil segmentation reduce the total inductance of each line, enabling optimization of coil frequency characteristics. A sensitivity and inductance values of coil with different structures were analyzed by finite element simulation, to find optimal structure of coil with the smallest inductance at the same precision. Combined simulation and experiment, the coil design was changed several times. Finally, we made a high frequency characteristics and high sensitivity magnetization detection coil, which is used for magnetization measurements in pulsed fields up to 60 T.

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