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Thu-Af-Po.05-09: Magnetostriction Measurement with π-Phase Shifted Fiber Bragg Grating under Pulsed High Magnetic Fields

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Under pulsed high magnetic fields, the interaction between the magnetic field and the spin of a material provides a unique opportunity to explore various magnetic properties, such as magnetization, dielectric polarization, and magnetostriction. These properties are critical for characterizing the diverse phase transitions that materials undergo. Among the measurement techniques available, magnetostriction measurement stands out for its exceptional sensitivity, allowing for the detection of intriguing phenomena that are often beyond the reach of traditional measurement methods. One of the most promising approaches in this field is the use of Fiber Bragg Grating (FBG) technology for magnetostriction measurement, particularly in environments subjected to pulsed high magnetic fields. FBGs are favored due to their remarkable insensitivity to vibrations and electromagnetic noise, making them ideal for precise measurements in challenging conditions.

In this study, we present the development of an FBG-based magnetostriction measurement system tailored for use under pulsed high magnetic fields. A key innovation in our approach is the introduction of a novel type of Bragg grating sensor known as the π-phase shifted FBG. This sensor design enhances measurement resolution significantly. Unlike conventional FBGs, the π-phase shifted FBG is characterized by a distinct narrow notch at the center of its reflection peak, which results in a reduced full-width at half-maximum (FWHM). Experimental tests have demonstrated that the integration of π-phase shifted FBGs into our measurement system can improve resolution by approximately 50% compared to traditional FBGs. This substantial enhancement underscores the considerable potential of π-phase shifted FBGs for advancing magnetostriction measurements in pulsed high magnetic field applications. The findings of this research pave the way for more sensitive and accurate investigations into the magnetic properties of materials, promising to facilitate deeper insights into their phase behavior and underlying mechanisms.

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