Visualization of magnetic field around the core of an electric motor by polarized pulsed neutron imaging

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The polarized neutron imaging is now regarded as one of the techniques, which visualize magnetic fields. Uniqueness of this technique is availability to the relatively thick magnetic objects and sensibility to the spatial magnetic field, because neutrons can penetrate deep inside the objects and can interact directly with field itself. In addition, the usage of pulsed neutrons, whose wavelength can be determined by means of Time-of-Flight method, enables quantification of the magnetic field strength and direction by efficient and precise analysis of wavelength dependence of neutron polarization. So far, the technical development of the polarized pulsed neutron imaging has been pursued in J-PARC Materials and Life science experimental Facility (MLF) and some application studies have carried out [1]. An interesting application is quantification and visualization of magnetic fields with time variation, e.g., alternating fields or magnetic fields in an electric motor, because they are widely used in the industrial equipment and studying their behavior is important for the power loss reduction. In this study, we have performed test experiments of a model electric motor in a static state to visualize the magnetic field distribution in the gap between the rotor and the stator.

The polarized pulsed neutron imaging experiments have been performed at the beam line of BL10 in MLF [2]. The model motor was housing-less structure and the gap distance was about 2 mm, which was slightly wider than practical ones, for convenience of experiment. The polarization change was observed in the gap position of the motor and corresponded with the magnetic field distribution expected from the rotor and stator configuration.

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References

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