

LASER INDUCED RESIDUAL STRESS ON Fe-3%Si GRAIN-ORIENTED STEEL

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Iron loss in Fe-3%Si grain-oriented steel sheet can be reduced by the laser-irradiation on the surface of the material. It has been considered that the residual stress introduced by the laser-irradiation induces the magnetic domain refinement and therefore the iron loss reduction.

In this study, the residual stress distributions near the laser spot were measured by synchrotron X-ray diffraction stress measurement methods for single crystal [1, 2] on the surface (BL6C, Photon Factory) and beneath the surface (BL22XU, SPring-8). The diameter of the laser pulse was 0.1 mm. The X-ray irradiated area was 30 μm in diameter for the surface stress measurement. The slit size was 50 μm x 50 μm for the stress measurement beneath the surface.

High tensile residual stresses were observed at the center of laser spot on the surface (Fig. 1). Compressive residual stress was observed just beneath the laser spot. The local residual stress distribution near the laser spot clarified in this study is useful to analyze the mechanism of the iron loss reduction and optimize the laser irradiation condition.

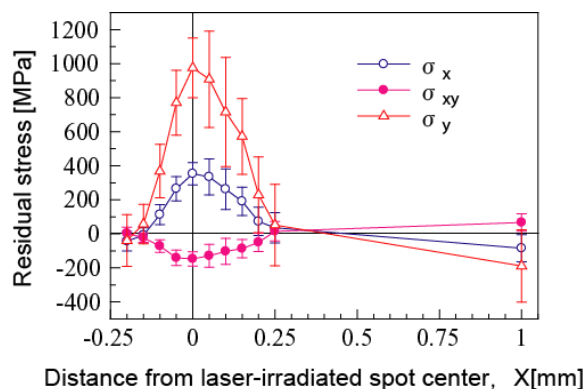


Fig. 1 Surface residual stress distributions on the laser irradiated Fe-3%Si grain-oriented steel (KEK-PF, 2009G165)

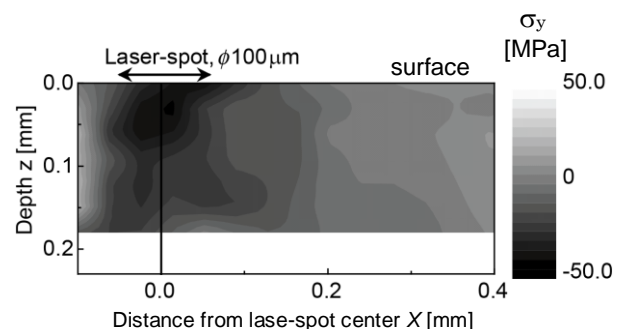


Fig. 2 Residual stress distribution beneath the surface of the laser irradiated Fe-3%Si grain-oriented steel (SPring-8, 2007A3772).

[1] H. Suzuki, K. Akita, H. Misawa, Jpn. J. Appl. Phys. Vol. 42, 2003, pp. 2876-2880, Pt. 1, No. 5A

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