

Core loss reduction by laser scribing in grain-oriented 3 % Si-Fe under different magnetizing direction

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To reduce the core loss of grain oriented silicon steel, various metallurgical attempt have been made, good orientation, thinner gage, small grain size, tensile coating and so on[1,2]. The laser scribing reduces the core loss of 3% Si-Fe steel [3], because subdomain induced by scribing produces many active domain walls, reducing the eddy current loss. However, there is no report for the variation of magnetic anisotropy, related to ac hysteresis loop, after laser scribing.

In this work, we measured the ac hysteresis loss loop and core loss loop as a function of the frequency (50 Hz, 60 Hz) at the magnetic induction of 1.3 T and 1.5 T of grain oriented 3 % Si-Fe steel before and after laser scribing.

The samples of dimensions 120 mm x 15 mm x 0.3 mm were pre-prepared with the angle 0° and 90° from [001] axis in (110)[001] grain oriented 3 % Si-Fe steel. The core losses were measured by single sheet method at induction 1.3 T and 1.5 T.

Fig.1 shows the change of the core loss before and after laser scribing. At the 0° and 90° samples, the reduction of core loss are 5.7 % and 30.3 % by laser scribing at 1.3 T and 60 Hz.

The scribe lines increase the sub-domain and surface resistivity of the material, resulting in reduced eddy current loss. Magnetic domain refinement results in the formation of sub-domains that are magnetized more easily than the larger main domains in ac magnetization process. As a result, the domain structure as a while becomes more homogeneous, suppressing such efforts as domain-wall bowing and distortion during magnetization.

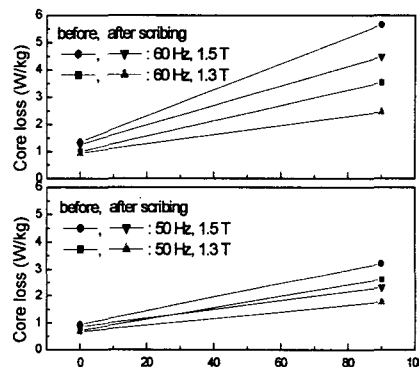


Fig.1. Change of core loss before and after laser scribing.

References

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