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軟强磁性體에서 바크하우젠 노이즈 의 殘留應力 과 Rolling Texture 에관한 效果

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The Effects of Rolling Texture and Residual Stress on Barkhausen Noise in soft Ferromagnetic Materials

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The Barkhausen noise, induction rate, dB/dt, and hysteresis loop have been measured simultaneously as a function of magnetizing frequency and the specimen angle, cut at various angle to the rolling direction, for 50% cold rolled polycrystalline permalloy of uniaxial magnetic anisotropy. The peak amplitude of the rectified Barkhausen noise envelpe and the induction rate decreased as the specimen cut angle increases due to the reduction of the induced voltage, $V(t)= V_0 \cos\theta$, with angle θ and the increase in impassable defects with a retarding force larger than the driving force. The hysteresis loss and Barkhausen noise energy also decreased with the specimen cut angle due to the increment of the impassible defects. The maximum power of the noise spectrum and the slope of the spectrum decreased markedly due to the reduction of clustering as the specimen angle increased. The power of the noise spectrum increased with the magnetizing frequency due to overlapping of the pulses. The Barkhausen noise envelope, induction rate and hysteresis curve also have been measured simultaneously as a fuction of maximum magnetic strength for annealed and tensile strained mild steel. The rectified Barkhausen noise envelope of annealed mild steel specimen consisted of two peaks in the knee regions of hysteresis curve, corresponding to the initial steep rise and sharp decrease in the dB/dt signal during half a cycle of magnetization, was accounted for the acceleration and deceleration of domain wall movement due to nucleation and annihilation of new reverse domain. The two peaks disappeared gradually as the maximum magnetic field intensity decreased from 4.79 to 2.395 KA/m due to lesser domain nucleation and annihilation process in the under-saturated state. The Barkhausen noise envelope changed to the single peak at the

coercive field as the residual strain increased from 6.7% due to increment of the dislocation pinning caused by strain hardening during irreversible wall displacement. The rapid increase in the hysteresis loss upto 6.7% residual strain, followed by gradual decreased with further straining, was explained in terms of the increment of dislocation density and the increase in the number of impassible defects due to the dislocation networks and groups, respectively. The decrement of the Barkhausen noise energy with the residual strain was due to the decrease in the energy for domain nucleation and annihilation, and a futher increase in the number of impassible defects. The two stage increase of the coercive field with plastic strain, $H_c \propto \varepsilon^{1/3}$ at $\varepsilon < 6.7\%$ and $H_c \propto \varepsilon^{1/6}$ at $6.7\% < \varepsilon < 35.5\%$, was due to dislocation multiplication and strain hardening. The increase in the maximum power of the noise spectrum and the decrease in the cut-off frequency with plastic strain were attributed to a strong clustering with the increment of dislocation density, while the increase in the maximum power and cut-off frequency with magnetizing frequency for the 6.7% strained mild steel were attributed to the overlapping of random pulses.

① J.W.Shilling and G.L.Jr Houze, IEEE Trans Magn. MAG-6 195 (1974).
② P.Mazzetti and G.Montalenti, Proc.Int. Conf. on Mag., p741 (1964).
③ S.Chikasumi, Physics of Magnetism, New York p289 (1968).
④ H.C.Kim, D.G.Hwang and B.K.Choi, J.Phys.D:Appl.Phys. 21,168(1988).
⑤ J.B.Goodenough, Phys. Rev. 95, 917 (1954).
⑥ D.G.Hwang and H.C.Kim. J.Phys.D:Appl.Phys. 21, 1807 (1988).

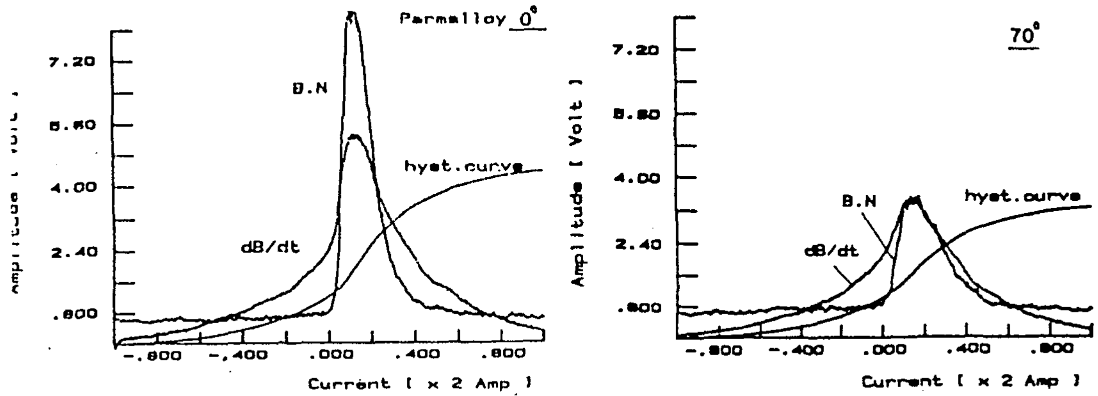

Fig.3 The rectified BN envelope, dB/dt signal and hysteresis curve in the 78.5%Ni Permalloy cut at 0°, 70° angles.