LIST OF FIGURES

Arrangement of magnetic domain in (a) 180° Domain

34

Figure 2.1

- Wall (b) 90° Domain Wall Figure 2.2 (a) Domain in the absence of magnetic field (b) 35 Arrangement of domain after magnetization Figure 2.3 A typical hysteresis loop formation (Srivastava et al. 36 2017) The influence of grain size on peak height of 40 Figure 2.4 Barkhausen noise (Pal'a and Bydzovsky, 2013) Figure 2.5 The variation in Barkhausen noise parameter with 41 tempering induced hardness change (Deng et al., 2018) Figure 2.6 The influence of surface roughness on Barkhausen 41 noise parameter (Deng *et al.*, 2018) Figure 2.7 43 (a) Correlation between MBN energy and residual stress (Gauthier et al. 1998) (b) The effect of residual stress on MBN (RMS) value (Kleber and Vincent, 2004) Figure 2.8 The effect of grinding process parameter on Barkhausen 43 noise emission (Thanedar et al., 2017) Figure 2.9 The relation between residual stress and Barkhausen 44 emission under different condition of heat treatment (Correa et al., 2016) Figure 2.10 The relation between residual stress and BN emission in 45 different zones of welded steel (Vourna et al., 2015) 46 Figure 2.11 Magnetic hysteresis loop for the sample subjected to (a) tensile deformation (b) Compressive deformation
- Figure 2.12 Correlation between reciprocal of MBN amplitude with 46 (a) applied stress (b) residual stress (Mierczak *et al.*, 2011)

(Piotrowski et al., 2017)

Figure 2.13 Variation in BN (RMS) with rise in grinding 47 temperature (Sridharan *et al.*, 2017)

- Figure 2.14Variation in event and count with residual stress during48grinding of hardened bearing steel (Vashista and Paul,
2011)2011)
- Figure 3.1 Heat treatment cycle for pack carburizing process 53
 Figure 3.2 shows the steps followed during carburizing/hardening 53 process (a) arrangement of sample inside box (b) sealing/packing of box using fire clay and sodium silicate (c) steel box inside muffle furnace (d) steel box in heated condition
 Figure 3.3 H455 HMT (Hindustan Machine Tools Ltd., India) 55
- Figure 3.3 H455 HMT (Hindustan Machine Tools Ltd., India) 55 surface grinding machine
- Figure 3.4 Micrograph showing the cross section of the ground 63 sample
- Figure 3.5Effect of tensile and compressive residual stress on64XRD peak position (Gazzara, 1983)
- Figure 3.6Magnetic Barkhausen noise set-up66
- Figure 3.7 Typical Barkhausen noise burst as received from 66 ground unhardened low carbon steel
- Figure 3.8 Typical Barkhausen noise burst as received from 67 ground hardened low carbon steel
- Figure 3.9Typical hysteresis loop as received from ground steel68
- Figure 4.1 Variation in tangential grinding forces with downfeed 70 under different work velocity conditions for (a) dry grinding (b) wet grinding
- Figure 4.2 Variation in normal grinding forces with downfeed 71 under different work velocity conditions for (a) dry grinding (b) wet grinding
- Figure 4.3 Variation of specific grinding energy with downfeed 72 under different work velocity conditions (a) dry grinding (b) wet grinding
- Figure 4.4Variation of grinding zone temperature with downfeed73under different work velocity conditions (a) dry

grinding (b) wet grinding

- Figure 4.5 Variation of surface roughness with downfeed under 75 different work velocity conditions (a) dry grinding (b) wet grinding
- Figure 4.6 SEM images of ground surface for (a) dry grinding, 76 (V_w-12m/min, downfeed- 6μm) (b) dry grinding, (V_w-12m/min, downfeed- 24μm) (c) wet grinding, (V_w-12m/min, downfeed- 6μm) (d) wet grinding, (V_w-12m/min, downfeed- 24μm)
- Figure 4.7 Variation in subsurface microstructure of ground 77 sample at 200x and at a downfeed of 24µm and work velocity of 12m/min for (a) dry grinding (b) wet grinding
- Figure 4.8Variation of microhardness under different downfeed,79work velocity and grinding condition (dry and wet)
- Figure 4.9 Microhardness profile of ground surface along the 79 depth from the surface under different grinding conditions
- Figure 4.10 X-ray diffraction profile of ground surface at highest 81 work velocity with lowest and highest downfeed condition (a) dry grinding (b) wet grinding
- Figure 4.11 Variation in peak shift with grinding zone temperature 82
- Figure 4.12Effect of grinding parameter on Barkhausen noise (a)83dry grinding (b) wet grinding
- Figure 4.13 Effect of surface roughness on Barkhausen noise 84
- Figure 4.14 Variation in as received Barkhausen noise signal 85 acquired from software for (a) higher peak shift/residual stress (b) lowest peak shift/residual stress conditions
- Figure 4.15Variation in root mean square value of Barkhausen85noise signal with peak shift
- Figure 4.16 Effect of grinding parameter on average permeability 86 (a) dry grinding (b) wet grinding
- Figure 4.17 Effect of surface roughness on average permeability 87

- **Figure 4.18** Variation in as received hysteresis loop acquire from 88 software for different peak shift condition for different work velocity (a) 8m/min (b) 12m/min Figure 4.19 Variation in average permeability value derived from 89 hysteresis loop with peak shift Figure 4.20 Variation in tangential grinding forces with downfeed 91 under different work velocity conditions for (a) dry grinding (b) wet grinding Variation in normal grinding forces with downfeed 92 Figure 4.21 under different work velocity conditions for (a) dry grinding (b) wet grinding Figure 4.22 Variation in specific grinding energy with downfeed 93 under different work velocity conditions (a) dry grinding (b) wet grinding Figure 4.23 Variation of grinding zone temperature with downfeed 94 under different work velocity conditions (a) dry grinding (b) wet grinding Figure 4.24 Variation of surface roughness with downfeed under 95 different work velocity conditions (a) dry grinding (b) wet grinding Figure 4.25 SEM images of ground hardened steel for (a) dry 96 grinding, $(V_w -12m/min, downfeed-6\mu m)$ (b) dry grinding, $(V_w - 12m/min, downfeed - 24\mu m)$ (c) wet grinding, (Vw -12m/min, downfeed-6µm) (d) wet grinding, $(V_w - 12m/min, downfeed - 24\mu m)$ Figure 4.26 Variation in subsurface microstructure of ground 97 sample at 200x for highest thermal damage (a) dry grinding (V_w -8m/min, downfeed-24 µm) (b) wet grinding (V_w -12m/min, downfeed-24 μ m) Figure 4.27 Variation of microhardness under different downfeed, 98 work velocity and grinding condition (dry and wet)
- Figure 4.28 Microhardness profile of ground surface along the 99 depth from the surface under different grinding

nditio

	conditions	
Figure 4.29	X-ray diffraction profile of ground hardened surface (a)	100
	dry grinding (b) wet grinding	
Figure 4.30	Variation in peak shift with grinding zone temperature	101
	for hardened steel	
Figure 4.31	Effect of grinding parameter on Barkhausen noise (a)	102
	dry grinding (b) wet grinding	
Figure 4.32	Variation in root mean square value of Barkhausen	103
	noise signal with peak shift for ground hardened steel	
Figure 4.33	A snapshot showing the Barkhausen noise signal	104
	obtained from hardened steel	
Figure 4.34	Effect of grinding parameter on average permeability	105
	for hardened steel (a) dry grinding (b) wet grinding	
Figure 4.35	Variation in average permeability value derived from	106
	hysteresis loop with peak shift during grinding of	
	hardened steel	
Figure 5.1	The correlation between (a) BN (rms), peak shift and	108
	grinding temperature (b) Average permeability, peak	
	shift and grinding temperature in unhardened steel	
Figure 5.1	The correlation between (a) BN (rms), peak shift and	109
	grinding temperature (b) Average permeability, peak	
	shift and grinding temperature in hardened steel	