APPENDICES

Appendix A: The chemical composition of austenitic stainless steels developed for biomedical applications (mass %).

Designation	C	Mn	Cr	Ni	Mo	N	Si	P	S	Cu	Nb	Fe
F 138 [211]	0.03 max	2.0 max	17.0-19.0	13.0-15.0	2.25-3.0	0.1 max	0.75 max	0.025 max	0.01 max	0.50 max	-	Bal
ASTM F1314 [89]	0.03 max	4.0-6.0	20.5-23.5	11.5-13.5	2.0-3.0	0.2-0.4	0.75 max	0.025 max	0.01 max	0.5 max	0.1-0.3	Bal
ASTM F1586 [90]	0.08 max.	2.0-4.25	19.5-22.5	9.0-11.0	2.0-3.0	0.25-0.50	0.75 max.	0.025 max.	0.01 max.	0.25 max.	0.25-0.80	Bal
ASTM F2581 [95]	0.15-0.25	9.5-12.5	16.5-18.0	0.05 max	2.7-3.7	0.45-0.55	0.2-0.6	0.02 max.	0.01 max	0.25 max	-	Bal
ASTM F2229 [94]/ Biodur 108 [68]	0.08 max	21.0-24.0	19.0-23.0	0.05 max	0.5-1.5	0.85-1.1	0.75 max	0.03 max	0.01 max	0.25 max	-	Bal
P2000/ X13CrMnMoN18-14-3 [115]	< 0.15	12-16	16-20	-	2.5-4.2	0.75-1.0	-	-	-	-	< 0.25	Bal
PANACEA P558 [118]	0.16	9.47	16.62	< 0.02	3.25	0.49	0.43	< 0.005	0.0002	0.02	0.026	Bal
BIOSSN4 [212]	0.029	12.58	17.05	0.03	2.38	0.43	0.42	0.014	0.007	1.44	-	Bal
0Cr18Mn15Mo2N0.64 [125]	0.044	15.8	18.62	0.03	2.78	0.64	0.18	0.013	0.004	-	-	Bal

Appendix B: Microstructure and mechanical behavior of nickel-free/negligible nickel, nitrogen stabilized austenitic stainless steel.

S. No.	Alloys/Composition	Experimental details	Findings	References
1.	Cr-19, Mn-10, N-0.63, Ni-0.8, Mo-0.16, C-0.03, Si-0.03	The tribological behavior was investigated by dry abrasion, abrasion-corrosion (synthetic mine water) and cavitation-erosion (in distilled water) techniques and compared with that of the 304 and Hadfield steel.	In a corrosive medium, Cr-Mn-N steel exhibited superior abrasion resistance and cavitation-erosion resistance.	1998 [97]
2.	P2000	Fatigue, chemical and sliding wear in Ringer's solution were studied. In vitro cytotoxicity was studied with MC3T3 cells.	It showed good corrosion, fatigue and tribological behavior and is recommended for biomedical application.	2002 [115,116]
3.	Biodur 108, 316L and 22Cr-13Ni-5Mn	Fatigue tests were conducted in Ringer's solution at 37°C as per ASTM F1801 up to failure or 10^6 cycles at 1 Hz frequency.	The S-N curve of Biodur 108 is significantly above the 316L and fatigue life decreased in Ringer's solution compared to distilled water for all three steels.	2003 [98]
4.	Fe24Mn13Cr1Ni0.44N, Fe24Mn18Cr3Ni0.62N	Tests under tensile loading were conducted at an elongation rate of 10 µm/min and 50 µm/min. The	Slip and twinning both the mechanisms were there during the testing.	2006 [99]

		microstructure was analyzed using in-situ SEM.		
5.	Fe-24Cr-2Mo (HFVM), Fe-24Cr-2Mo-1N (NA-1) and Fe-23Cr-1Mo-1N (P-ESR)	High cycle fatigue test at stress ratio (R) of 0.1in air and PBS solution kept at 310°K and pH 7.5 bubbled with nitrogen-4% O_2 gas mixture, with 20 Hz frequency in air and 2 Hz in PBS solution.	No significant difference between S-N curves was there in air and in PBS for each steel. The fatigue strength at 10^7 cycles for the NA alloy and P-ESR alloy was 245 MPa and 320 MPa, respectively.	2009 [102]
6.	Fe24Mn13Cr0.44N	Bend rotating cyclic tests were performed at room temperature at 40 Hz frequency and R= -1	The fatigue strength at 10^7 cycles was 341 MPa.	2009 [101]
7.	ASTM F2229 and 316L in cold rolled condition (20-30%)	Fatigue tests were performed at RT with R=0.053 and frequency of 1 Hz. Tests were interrupted to analyze the crack initiation mechanisms.	Cracks were preferentially initiated along annealing twin boundaries for ASTM F2229, whereas for 316L, cracks initiated along intrusions and extrusions associated with slip.	2013, 2014 [100,210]
8.	HNS (C-0.022, Si-0.15, Mn-0.10, P< 0.05, S-0.0005, Ni-0.04, Cr-23.78, Mo-0.96, N-1.05) and 316L (20% cold rolled)	Fretting fatigue behavior of HNS was studied in air and PBS kept at pH of 7.5 and temperature of 310 °K and aerated with 4% O_2 containing N_2 gas mixture. Tests were conducted at R of 0.1 at 20 Hz and 2 Hz frequency in air and PBS	Fatigue strength of HNS at 10^7 cycles was 320 MPa in air and PBS and was comparable to that of 316L. The fretting fatigue was 280 MPa and 240 MPa in air and PBS, respectively. The plain fatigue of HNS was lower than that of 316L (350 and 320 MPa)	2013 [103]

		solution, at a contact pressure of 30 MPa	whereas, the fretting fatigue limit was significantly higher than that of 316L (180 MPa).	
9.	Cr-17.97, Mn-18, N-0.63, C-0.056, Al-0.02	Tests were performed under tensile loading at strain rates of 10^{-4} and 10^{-2} /sec. LCF tests were performed at RT at a constant frequency of 0.5 Hz and different strain amplitudes.	Increase in strength and decrease in elongation was observed with increasing strain rate. The plastic deformation behavior was well fitted with modified Ludwik relation. Cracks nucleation was at grain boundaries or along slip bands at higher strain rate, whereas at lower strain rate, they initiated preferably at inclusions. There was fall in fatigue life with rise in strain amplitude. Cyclic softening was there from the initial cycle.	2015 [104,107]
10.	316, 316LVM, $316MnN_1$, $316MnN_2$, $316MnN_3$,	Tensile and hardness tests at RT	There was increase in hardness and strength with increase in nitrogen content while decrease in ductility.	2015 [105]
11.	Cr-22, Mn-17, Mo-2.43, N-0.83, C-0.02, Si-0.27, Nb-0.21, P-0.012, S-0.004	Tensile tests were carried out at RT at different strain rates ranging from 10^{-4}/sec to 1/sec in the solution treated, hot rolled and cold rolled condition	This steel exhibited two-stage strain hardening behaviour. There was increase in YS and UTS with increase in strain rate but decrease in elongation.	2017 [108,109]

12.	Fe-18Cr-10Mn-0.4N and Fe-18Cr-10Mn-0.6N	High cycle fatigue tests were conducted with R=0.1 at 10 Hz frequency	Fatigue limits of 0.4N and 0.6N at 10^7 cycles were 425 MPa and 475 MPa, respectively. Both the steels have similar UTS, but YS of 0.6N (537 MPa) is higher than that of 0.4N (445 Mpa)	2017 [106]

Note: SEM: Scanning electron microscopy; PBS: Phosphate buffer saline; YS: Yield strength; UST: Ultimate tensile strength; RT: room temperature

Appendix C: Electrochemical corrosion study of nickel-free/negligible nickel, nitrogen stabilized austenitic stainless steel.

S. No.	Alloys/Composition	Experimental details				Findings	References
		Medium/solution	pH	Temp.	Methods		
1.	C-0.2, Cr-17.35, Mn-10.18, Mo-3.09, N-0.49	PBS, MEM, MEM+10% FCS, MEM+10% FCS + L929 cells	-	-	EIS	Two maxima observed in the bode phase spectra indicate the presence of one inner passive layer whose resistance increased with immersion time related to uniform corrosion and one outer porous layer.	2005 [111]
2.	C-0.048, Cr-18.44, Mo-2.23, Mn-15.96, Si-0.24, P-0.004, S-0.017, N-0.66	XM H_2SO_4+ 0.5M NaCl, 0.5M H_2SO_4 + 0.25M Na_2SO_4	-	-	Potentiodynamic polarisation, EIS, Mott-Schottky and XPS	Passive film formed in NaCl was stable, but stability decreased with the addition of H_2SO_4. Passive film formed on acidic Na_2SO_4 was superior to acidic NaCl	2009 [110]
3.	HNS A (19.8 Cr, 18.4 Mn, 0.82 N, 0.04 C, 0.012 S, 0.015 P, 0.02 Al), HNS B (19.07 Cr, 18.84 Mn, 2.20 Mo,	3.5% NaCl, 0.5 M NaCl + 0.5 M H_2SO_4	-	RT	Potentiodynamic polarisation, EIS	HNS exhibited higher resistance against pitting than that of the 316L in both mediums. There was no significant effect of the addition of Mo.	2009 [66]

	0.77 N, 0.043 C, 0.012 S, 0.015 P, 0.02 Al), HNS C (18.4 Cr, 15.8 Mn, 2.19 Mo, 0.66 N, 0.24 Si, 0.04 C, 0.005 S, 0.017 P, 0.02 Al) and 316L						
4.	A1 (19.56 Cr, 19.4 Mn, 2.29 Mo, 0.82 N, 0.049 C, 0.19 Si, 0.003 S, 0.04 Al), A2 (19.84 Cr, 18.9 Mn, 2.26 Mo, 0.88 N, 0.022 C, 0.19 Si, 0.002 S, 0.02 Al), A3 (19.55 Cr, 19.5 Mn, 2.26 Mo, 0.96 N, 0.058 C, 0.19 Si, 0.003 S, 0.04 Al) and 316L	3.5 % NaCl with addition of HCl and NaOH	1, 3, 6, 7 and 9	30 °C - 70 °C	XPS, Potentiodynamic polarisation and EIS	Nitrogen steels had better resistance against pitting and crevice corrosion than that of 316L. Increase in pitting resistance and CPT was observed with increase in nitrogen content. A relation between CPT and MARC is given as : CPT= 2.55 MARC – 29	2009 [84]

5.	00Cr18Mn15Mo2N0.62	Hank's solution	-	37 °C	Potentiodynamic polarisation, platelet adhesion and tensile test	Better corrosion resistance and blood compatibility as compared to 316L. YS and UTS of 537 MPa and 884 MPa, respectively was observed.	2009 [123]
6.	P558 and ISO 5832-9	MEM	-	37 °C	Potentiodynamic polarisation and EIS	Electrochemical corrosion resistance was comparable to that of the ISO 5832-9	2010 [117]
7.	Fe-17Cr-15Mn-2Mo-(0.5-1.0)N (HNS) and 317L	PBS, PBS with 0.1 g/L of albumin and PBS with 0.1g/L of fibrinogen	7.4	37 °C	EIS, cyclic voltammetry (CV), Mott-Schottky	HNS exhibited a more protective passive layer of higher thickness with increase in nitrogen content. Passive films showed n-type semiconductor behavior and decrease in donor density was observed with increase in nitrogen.	2012 [112]
8.	N1 (18.4 Cr, 15.96 Mn, 2.23 Mo, 0.52 N, 0.048 C, 0.24 Si, 0.004 S, 0.017 P), N2 (18.4 Cr, 15.96 Mn, 2.23 Mo, 0.66 N, 0.048 C, 0.24 Si, 0.004 S, 0.017 P), N3	0.5 M NaCl + 0.5 M H_2SO_4	-	-	EIS	It is suggested that the addition of nitrogen accelerates the dissolution process, which is attributed to the accumulation of passivation species and improvement in passivity.	2015 [113]

	(18.9 Cr, 18.9 Mn, 2.28 Mo, 0.96 N, 0.058 C, 0.2 Si, 0.003 S, < 0.03 P)						
9.	HNS (0.18-0.186 C, 12.6-12.61 Mn, 17.4-17.5 Cr, 3-3.2 Mo, 0.5-0.51 N, 0.06-0.07 S, 0.013-0.014 P, 0.41-0.42 Si) and 316L	Ringer’s solution and Artificial saliva solution	6.5-7.5		Potentiodynamic poalarisation, Pin on disc tribocorrosion at normal loads of 2 and 10 N	HNS showed higher pitting resistance as compared to 316L under static as well as under applied load.	2018 [114]

Note: RT: Room temperature; PBS: Phosphate buffer saline; FCS: Fetal calf serum; MEM: Minimum essential medium; EIS: Electrochemical impedance spectroscopy; XPS: X-ray photoelectron spectroscopy; CPT: Crevice pitting temperature; MARC: Measure of alloying for resistance to corrosion

Appendix D: Effect of treatment of surface through surface mechanical attrition and ultrasonic shot peening on various properties of metallic materials.

S. No.	Alloys	Experimental details				Findings	References
		Shot size	Peening Duration (min)	Frequency (Hz)	Methods		
1.	AISI 316L	3	30	20k	Tensile tests of the nanocrystalline 316L stainless steel at RT	It exhibited an extremely high tensile strength of 1450 MPa	2005 [144]
2.	AISI 316L	8	60	50	Corrosion in 0.05M H_2SO_4 + 0.25M Na_2SO_4	Improvement in corrosion resistance	2006 [213]
3.	AISI 316L	2, 3	15	20k	High cycle fatigue at R= -1 at 10Hz frequency in air	Increase in fatigue life and fatigue limit with increase in shot size	2006 [158]
4.	AIS 316L	3	30	20k	Ball on disc sliding wear test in ambient condition	Increase in wear resistance following USP	2006 [214]
5.	SS 400	8	15	50	High cycle fatigue at R=0 at 40Hz frequency in air	Fatigue strength increased by 13.1%	2009 [215]

6.	AISI 409	2, 5, 8	15, 30, 45	50	Corrosion in 0.6M NaCl	Increase in corrosion resistance with 2 mm shots whereas decrease with bigger shots	2010 [193]
7.	AISI 304	2, 5, 8	15, 30, 45, 60	50	Corrosion in 0.6M NaCl	No significant effect	2013 [194]
8.	IN 718	3	45, 60, 90	20k	Tensile test at RT	Marginal increase in strength	2014 [216]
9.	AISI 304	6	180	40	Tribocorrosion in 0.9% NaCl solution	Wear rate decreased by 2 to 4 times following SMAT	2014 [217]
10.	AISI 304	2, 5, 8	15, 30, 45, 60	50	Corrosion in Ringer's solution	Increase in corrosion resistance with 2 mm shots and decrease with bigger shots	2015 [170]
11.	Al 2014	3	10	20k	LCF tests at total strain amplitudes of ±0.375 %, ±0.40 %, ±0.50 % and ±0.55%. High cycle fatigue at ±180 MPa.	A significant increase in fatigue life.	2015 [218]
12.	Mg-6Gd-3Y-0.5Zr	8	3	20k	Dry sliding wear	Decrease in wear resistance after SMAT	2015 [154]
13.	Titanium	3	30	50k	Ability to new bone formation is assessed by in vitro cell adhesion, proliferation,	There was a significant increase in Osseo-integration following USP	2015 [131]

					differentiation and mineralisation		
14.	AISI 316L	5	2	20k	Cell culture, cell adhesion and proliferation, using human osteoblast cell (Saos-2)	Enhancement in cell attachment, spreading and proliferation rate following USP	2017 [129]
15.	AISI 316, AISI 690	3	15, 30, 45, 60	20k	Corrosion at RT and 300 °C in simulated steam generators (SG) environment.	Corrosion resistance decreased at RT, whereas it increased in simulated SG environment.	2017 [127]
16.	AISI 316L	3	-	20k	LCF tests at strain amplitudes of ±0.50 %, ±0.80 %, ±1.0 % and ±1.25 %	Decrease in fatigue life at a higher strain amplitude of ±1.25 whereas no effect at lower strain amplitudes.	2017 [165]
17.	Ti-6Al-4V	3	5	20k	LCF tests at strain amplitudes of ±0.60 %, ±0.65 %, ±0.70 %, ±0.80 %, ±0.90 %, ±1.0 %	Enhancement of fatigue life at lower strain amplitudes whereas no effect at higher strain amplitudes of ±0.90 % and ±1.0 %	2017 [132]
18.	Al 7075	3	0.25, 0.5, 1 and 5	20k	Corrosion resistance in 3.5% NaCl	Enhancement of corrosion resistance for 0.25 min of USP	2017 [133]

19.	Al 7075	3	0.5, 1, 3, 5	20k	LCF tests at strain amplitudes of ±0.38 %, ±0.40 %, ±0.45 %, ±0.50 %, ±0.55 %, ±0.60 %	Increase in fatigue life with increase in USP duration	2017 [134]
20.	MG-AZ31B	2, 3	15	20k	Corrosion fatigue in 3% NaCl	Improvement in corrosion fatigue life following SMAT	2019 [153]
21.	Co28Cr6Mo	3	15	20k	Corrosion in Ringer's solution	Enhancement in corrosion resistance	2018 [128]

Note: RT: Room temperature; R: stress ratio; LCF: Low cycle fatigue; HCF: High cycle fatigue; SMAT: Surface mechanical attrition treatment; USP: Ultrasonic shot peening

Appendix E: Effect of cold rolling and severe plastic deformation on various properties of the nickel free (or negligible nickel) nitrogen stabilised austenitic stainless steel.

S. No.	Alloys/Composition	Experimental details	Findings	References
1.	C-0.04, Cr-18.4, Mn-15.8, Mo-2.19, N-0.66, Si-0.24, S-0.005, P-0.017	Cold reduction in thickness was done to 8, 30, 40, 49 and 60%. Potentiodynamic and EIS tests were performed in 3.5% NaCl, 0.5 M NaCl + 0.5 M H_2SO_4 and 0.5 M NaCl + 0.5 M NaOH solution.	A decrease in pitting potential was observed in a solution of 3.5 % NaCl due to an imperfect and less protective passive layer formed, attributed to the defects induced by the cold rolling. However, no appreciable reduction in corrosion resistance was observed in 0.5 M NaCl + 0.5 M H_2SO_4 and 0.5 M NaCl + 0.5 M NaOH solution.	2008, 2009 [219,220]
2.	316L, 316LVM, 316MnN$_1$ (0.34), 316LMnN$_2$ (0.43), 316LMnN$_2$ (0.52)	Samples were cold rolled for 10 and 20 % thickness reduction. Tensile tests, hardness and microstructural study was conducted. Cell adhesion and MTT assay tests were also performed for DL cells to evaluate cytotoxicity. The corrosion resistance in SBF environment was evaluated at 37 °C using EIS and polarisation techniques.	There was no phase change, but strength and hardness increased with increase in cold reduction. Nitrogen-containing steels showed higher cell proliferation as compared to 316L and 316LVM. Cell proliferation increased with cold reduction. Corrosion resistance increased with increasing nitrogen content and cold working.	2013 [105,206,221]

3.	C <0.08, Si- 0.2-0.6, Mn-18-18.7, Cr-18-20, V< 0.2, N-0.51	Samples were cold compressed for 10, 20, 30, 40 and 50% at strain rate of 0.05/sec at RT.	Strength increased with increase in the cold compression.	2014 [208]
4.	C-0.076, Mn-19.78, Cr-17.96, Si-0.34, N-0.543, P-0.051, S-0.007, Ni-0.16, Mo-0.11, Cu-0.01	USP was carried out with 3 mm shots at 80 µm amplitude with 20kHz frequency for different duration. Low cycle fatigue behaviour was studied following 10 minutes of USP.	There was decrease in fatigue life following USP as compared to non-USP.	2014 [167]
5.	00Cr18Mn15Mo2N0.86	Samples were cold deformed at different levels of 10, 20, 30, 40 and 50% and electrochemical corrosion tests of polarisation and EIS were performed in 0.9% saline at 37 °C.	There was no significant change in pitting potential.	2016 [166]
6.	C-0.014, N-0.9, Cr-18.3, Mn-15.3, Mo-2.4, Si-0.31, S-0.009, P-0.01	20% and 35% pre-strained fatigue samples were tested in air and PBS solution kept at 37 °C, at R=0.1 for 10^7 cycles.	Fatigue and corrosion fatigue limit of non-strained sample was found 550 MPa and 475 MPa, respectively, and there was increase in fatigue limit and fatigue life with increasing pre-straining.	2018 [168]

Note: RT: Room temperature; PBS: Phosphate buffer saline; EIS: Electrochemical impedance spectroscopy; USP: ultrasonic shot peening; R: Stress ratio

Appendix F: Glossary of words [222, 223, 224].

Acute: Duration of less than 30 days.

Biocompatibility: The ability of a material to perform with an appropriate host response in a specific application. It may also be defined as "biological performance of a material in a specific application that is judged suitable to that situation".

Biological environment: Conditions encountered within an animal or human body.

Breakdown potential: The potential at which there is breakdown of passive film and drastic increase in corrosion current with little increase in potential.

Capsule: Tissue surrounding an implant produced by local host response.

Cell culture: Growth of cells dissociated from the parent tissue by spontaneous migration or mechanical or enzymatic dispersal.

Corrosion potential: Potential at which rate of anodic dissolution of the electrode equals the rate of cathodic reaction. It is also called zero current potential or open circuit potential.

Cyclic stress amplitude: It is half of the algebraic difference between the maximum and minimum stress in a cycle.

Cytotoxic: Having a deleterious effect on cells.

Cytotoxicity: Cellular damage to one or more metabolic pathways, intracellular processes, or structures resulting in impaired function. Often, but not necessarily, linked to loss of viability.

Elastic strain amplitude, cyclic: It is half of the algebraic difference between the maximum and minimum elastic component of strain in a cycle.

Endurance limit: It is the stress limit below which materials are supposed to run for infinite number of cycles. In general, it is defined for 10^7 or 10^8 cycles of cyclic loading.

Fatigue failure: Materials subjected to a repetitive or fluctuating stress will fail at a stress much lower than that required to cause fracture on a single application of load. Failure occurring under such conditions of dynamic loading are called fatigue failure.

Frequency: Number of cycles per second

Hemocompatibility: Compatibility of material with blood.

Hemolysis: Release of hemoglobin due to damage to red blood cells.

Implant: A medical device made from one or more biomaterials that is intentionally placed within an animal or human body by the act of implantation.

Implantation: Placement of a device or material within the body of an animal of human by a medical or surgical professional, in such a way as to breach one or more epithelial layers and to leave materials and/or components in place after the initial procedure is completed.

In vitro: Literally, “in glass”, but used conventionally to mean cultured outside of the host as cell cultures, organ cultures, or short-term organ bath preparations.

In vivo: In the living plant or animal.

Local Host response: The response, other than the intended therapeutic response, of tissue and organs contacting a biomaterial.

Passive film: The ultra-thin oxide layer formed on the surface which protect against corrosion.

Physiological environment: Controlled chemical (inorganic) and thermal conditions simulating a portion of a biological, biophysiological, or pericellular environment.

Pitting: Formation of spots or pits on the surface due to localised corrosion.

Plastic strain amplitude, cyclic: It is half of the algebraic difference between the maximum and minimum plastic component of strain in a cycle.

Prosthesis: A device that replaces a limb, organ, or tissue of the body.

Stress ratio (R): It is the ratio of minimum stress to maximum stress in a cycle.

Total strain amplitude, cyclic: It is half of the algebraic difference between the maximum and minimum strain in a cycle.

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List of Publications/Patents

Patent

Title: A composition of austenitic stainless steel for medical implants, Indian Patent. Patent number 202011015355, Application date: 07.04.2020.

International Peer-Reviewed Journals

1. **Chandra Shekhar Kumar**, Gaurav Singh, Suruchi Poddar, Neelima Varshney, Sanjeev Kumar Mahto, Arijit Saha Podder, Kausik Chattopadhyay, Amit Rastogi, Vakil Singh and Girija Shankar Mahobia, *"High-manganese and nitrogen stabilized austenitic stainless steel (Fe-18Cr-22Mn-0.65N): a material with a bright future for orthopedic implant devices"*, Biomedical Materials, 2021, Vol. 16, PP. 065011.

2. **Chandra Shekhar Kumar**, Kausik Chattopadhyay, Vakil Singh and Girija Shankar Mahobia, "*Enhancement in low-cycle fatigue life of high-nitrogen austenitic stainless steel at low strain amplitude through ultrasonic shot peening*", Materials Today Communications, 2020, Vol. 25, PP. 101576.

3. **Chandra Shekhar Kumar**, Girija Shankar Mahobia, Arijit Podder, Sanjeev Kumar, Rahul Kumar Agrawal, Kausik Chattopadhyay and Vakil Singh, "*Role of ultrasonic shot peening on microstructure, hardness, and corrosion resistance of nitrogen stabilised stainless steel without nickel*", Materials Research Express, 2019, Vol. 6, Issue 9, PP. 096578.

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4. **Chandra Shekhar Kumar**, Girija Shankar Mahobia and Kausik Chattopadhyay, "*Effect of ultrasonic shot peening on strain controlled fatigue behaviour of low nickel austenitic stainless steel"*, Materials Today: Proceedings, 2020, Vol. 28, PP. 808-812.

5. Girija Shankar Mahobia, **Chandra Shekhar Kumar** and Kausik Chattopadhyay, "*Nanocrystallisation of nickel free high nitrogen austenitic stainless steel through ultrasonic shot peening*", Key Engineering Materials, 2019, Vol. 813, PP. 43-48