COMPARISION OF MECHANICAL PROPERTIES OF NITRIDED CASES AND REMELTED LAYERS OF AUSTENITIC STAINLESS STEEL

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1. Instroduction

The austenitic stainless steels have very high general corrosion resistance, but they have low hardness and wear resistance. Nowadays, material technologies like laser remelting and low-temperature glow-discharge nitriding process can improve mechanical properties of austentic stainless steel without decrease the corrosion resistance. Laser remelting influence on refinement of microstructure and homogenizing of chemical composition of alloys was studied in ref[1–4]. If the austenitic stainless steels are subjected to glow-discharge nitriding process in low temperature, loss of corrosion resistance is not observed. At the temperatures above 450 °C, the precipitation of CrN was observed. The limiting temperature of nitriding process could be about 450 °C, according to the[5–8].

The aim of this article is an analyse of local mechanical properties of nitrided cases and remelted layers after the low temperature glow-discharge nitriding process and laser remelting, respectively.

2. Experimental procedures and results

Every test specimens (diameter of 20 mm and height of 6 mm) were made of austenitic stainless steel type X5CrNi18-10. Young's modulus of the steel substrate is approximetely 200±14 GPa and its hardness is about 220±3 HV20. The specimens were subjected to glow-discharge nitriding process at the temperature of 450 °C. Chemical composition of gas mixture during the termochemical treatment was different. Parameters of nitriding process are shown in Tab. I.

The same steel type X5CrNi18-10 was subjected to laser remelting. Laser remelting was done by means of laser MLT 2500 CO_2 (wavelength 10.6 µm) in argon atmosphere. During the laser remelting process no. 5 and 6 the specimens were also immersed in liquid nitrogen. The laser beam dimension 1×20 mm was used. Tab. II presents parametres of laser treatment.

Table I
Parametres of the glow-discharge nitriding process

Number of process	Vacuum pressure [hPa]	Time [h]	Temperature [°C]	Atmospheric composition	
				N_2	H_2
1	4	6	450	10	90
2	4	6	450	50	50

Representative picture of remelted layers is presented in Fig. 1. After laser remelting the surfaces were grinded off through 1200 grit SiC papers. The depth of the remelted layers depended on the laser power. Generally, the increase of the power caused a rise of thickness of the remelted layers.

Investigation of mechanical properties was carried out by using hardness tester with mounted Berkovich indenter. Mechanical properties of the diffusion layers were

Table II
Parametres of the laser remelting

Number of process	Scanning velocity [m min^{-1}]	Power [kW]	Scanning velocity [m min^{-1}]
3	2	2	0,25
4	2	5	0.25
5	2	2	0.25
6	2	5	0.25

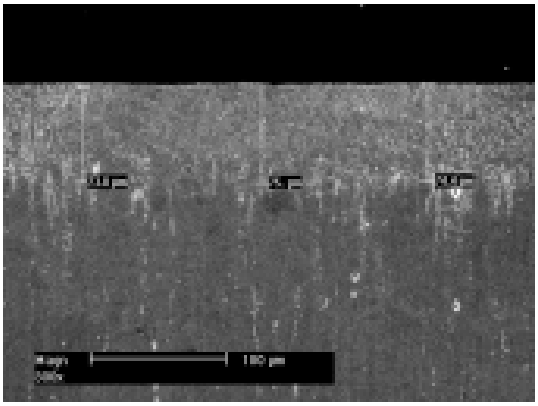

Fig. 1. Microstructure of remelted layer after process laser remelting

Table III
Mechanical properties of nitrided and remelted layers

Process	Nano hardness [HV]	Young's modulus [GPa]	Load [mN]
1	614±55	211±28	10
	524±71	201±19	20
	465±44	187±16	30
2	1056±13	232±28	10
	861±98	228±19	20
	737±59	198±18	30
3	352±32	227±17	10
	337±36	213±18	20
	327±22	192±16	30
4	412±42	235±21	10
	411±38	206±18	20
	330±22	192±19	30
5	432±67	227±23	10
	394±42	213±21	20
	377±43	192±17	30
6	432±54	235±26	10
	400±43	206±20	20
	368±32	192±14	30

examined on the surface of specimens using a different loads. Results of surface hardness were obtained by using different loads, respectively: 10, 20, 30 mN. Research was done by means of CSEM NanoHardnessTester (NHT) produced in Switzerland. Oliver-Pharr method was used for calculation of modulus. The value of Poisson's ratio was 0.3. Nanohardness was automatically recalculated between scales and presented in Vickers hardness scale. The results are shown in Tab. III.

3. Conclusion

1. Glow-discharge nitriding process has beneficial influence on nanohardness and Young's modulus.
2. The increase of nitrogen content in gas mixture influence on higher value of Young's modulus.
3. Laser remelting caused the refinement of microstructure in obtained surface layer.
4. Laser remelting process has beneficial influence on nanohardness and Young's modulus.

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A. Sitko, M. Szkodo, and B. Śniegocka *(University of Technology in Gdańsk, Faculty of Mechanical Engineering, Department of Materials and Welding Engineering, Poland):* **Comparison of Mechanical Properties of Nitrided Cases and Remelted Layers of Austenitic Stainless Steel**

This article presents the results of nanohardness and Young's modulus of nitrided cases and remelted layers. The nitrided cases were obtained by using the glow-discharge nitriding process at the temperature of 450 °C. The termochemical treatment was done by using a different chemical composition of gas mixture (N_2:H_2). The laser remelting was done by using the TRUMPF laser TLF 6000 turbo in Kielce. The laser remelting was done by using different parameters of termochemical treatment. Investigation of mechanical properties was carried out by using hardness tester with mounted Berkovich indenter. Mechanical properties of the diffusion and remelted layers were examined on the surface of specimens using different loads.