International Journal of Advanced Research and Review

www.ijarr.in

INFLUENCE OF LASER BEAM HARDENING UPON ITROCARBURATE COATINGS

Assoc.prof.dr. Olàh Arthur
Transilvania" University of Braşov, Department of Materials Engineering and Welding, Braşov, ROMANIA,
oart@unitbv.ro

ABSTRACT
The laser appliance used also for superficial hardening is made – in principle – of a reflecting cavity calledresonator, with special mirrors and a reflecting capacity that is basically zero. These are positioned face to face and filledwith a special active medium – in solid, liquid or gaseous state – in which the phenomenon of electron population inversionmay take place.The paper present the influence of laser beam hardening upon nitrocarburate structures. Research was madeon two categories of carbon steel for buildings namely C 30 and C 45. After nitrocarburising was made a laserhardening.

Keywords: nitrocarburising, laser beam, microsructures, microhardness

THEORETICAL ASPECTS
The laser appliance used also for superficial hardenings is made – in principle – of a reflecting cavity calledresonator, with special mirrors and a reflecting capacity that is basically zero. These are positioned face to faceand filled with a special active medium – in solid, liquid or gaseous state – in which the phenomenon of electronpopulation inversion may take place.

The inversion is done by a pumping appliance that "pumps" the energy into the active medium. Thereforeconditions are being created for electrons to pass from a level with higher energy to one with lower energy andfor the appearance of a surplus of photons in the active medium that are meant to magnify the intensity ofradiations sent out.

Magnification increases with the distance from the transmitting mirror to the reflecting mirror and this is wherethe reflection and the adsorption intensity are being exceeded and the surplus of photons leaves the activemedium, passes through the mirror O2 (figure 1) and is emitted into the environment with the shape of astimulated radiation that is the laser radiation.

2. EXPERIMENTAL RESEARCH
Research was made on two categories of carbon steel for buildings namely C 30 and C 45.

In a re-mellowed state the samples were submitted to nitrocarburation at 570^{0}C temperature, in a mixture of50%CO + 25%NH4 + 25%N with a maintenance duration of $360^{/}$ and $480^{/}$.
Subsequent to nitrocarburation the tryouts were submitted to thermal treatment in solid status with laser beam ona Triumph machine – TLC 105 with gaseous active medium - CO2 with a maxim power of 5 kW.Hardening was done at a 50 kHz frequency and at 1,25 kW representing 25% of the maximum power.Figure 1 presents the scheme of Trumph – TLC 105 laser appliance, utilized for laser heat treatment.

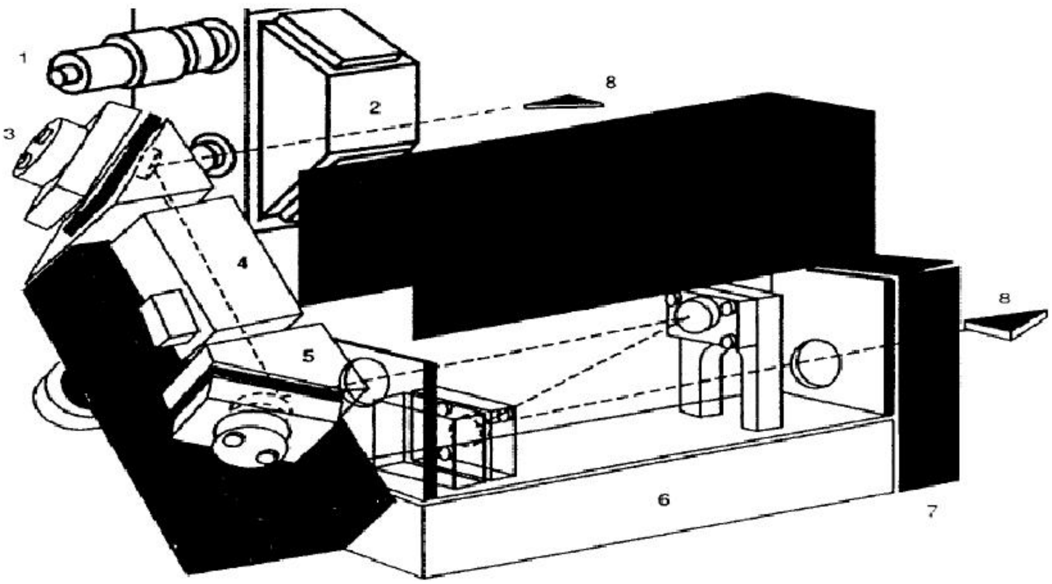
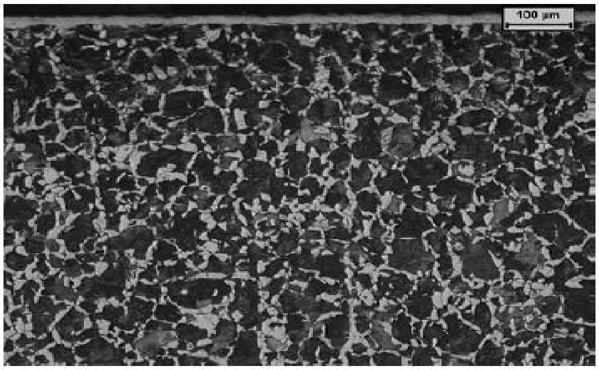


Fig. 2: Laser appliance scheme – Trumph – TLC 105

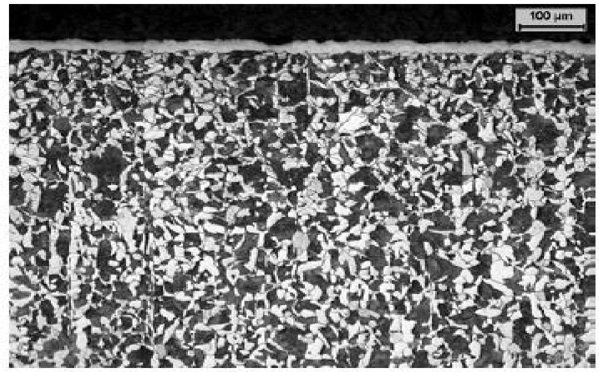
EXPERIMENTAL RESULTS

Table 1: Nitrocarburate coating thickness

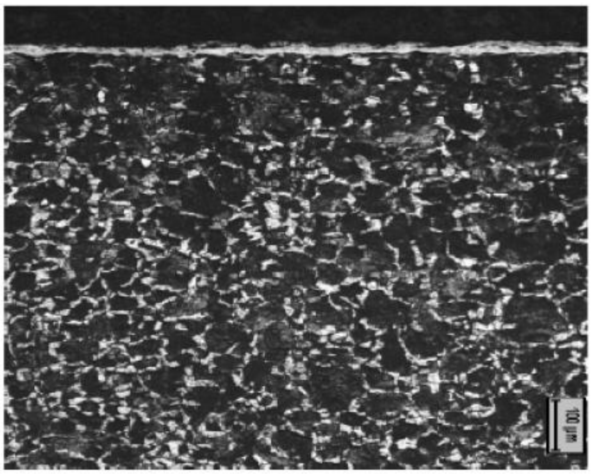
Maintenace time	**$480^{\backslash}$**		**Subsequent to laser beam hardening**	
Steel Brand	**C 45**	**C 30**	**C45**	**C30**
Nitrocarburate thickness coating [μm]	23,94	21,93	19,54	23,33
	21,67	24,57	19,28	26,82
	20,41	21,42	18,40	23,03
	19,53	20,41	18,65	23,28
	23,18	21,42	17,89	22,27



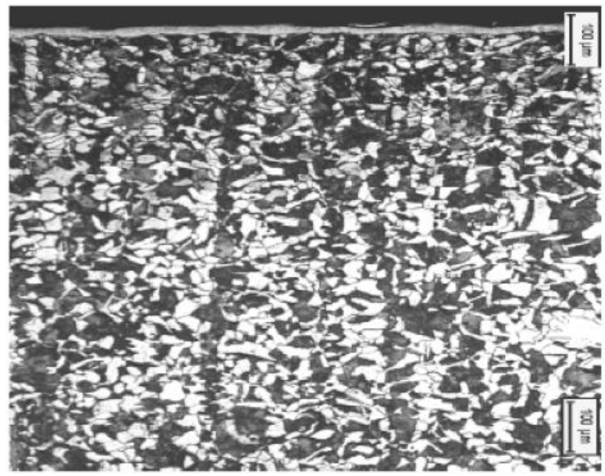
a) OLC 45 – Nitrocarburation at 570^{0}C, Maintenance time = 480$^{/}$, X 100



b) OLC 30 – Nitrocarburation at 570^{0}C, Maintenance time = 480$^{/}$, X 100



c) OLC 45 – Nitrocarburation at 570^{0}C, Maintenancetime = 480$^{/}$ + Laser Hardening X 100



d) OLC 30 – Nitrocarburation at 570^{0}C, Maintenance time = 480$^{/}$ + Laser Hardedning X 100

Fig. 4: Microstructures

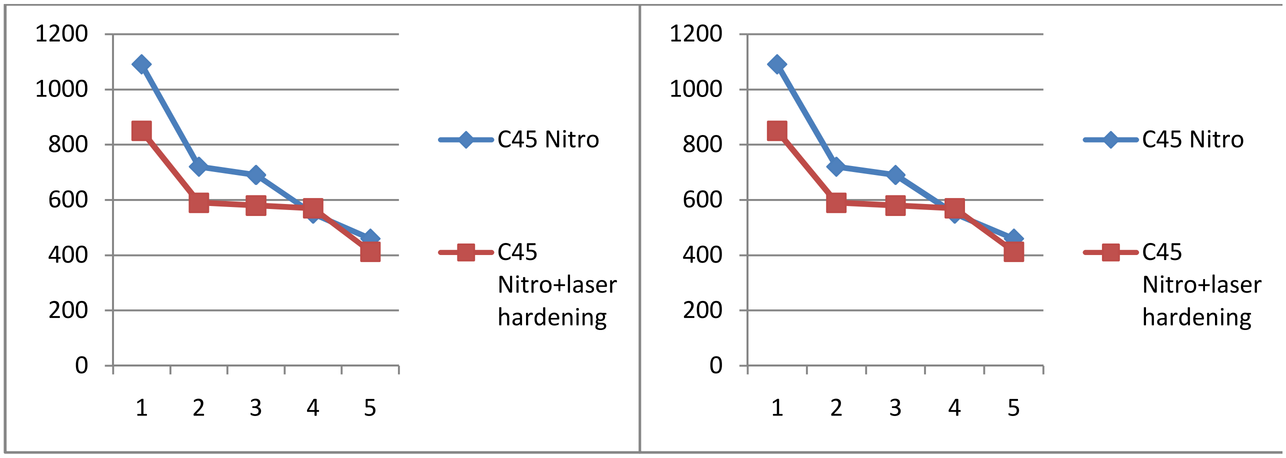


Fig. 5: Variation of microhardness after nitrocarburising and nitrocarburising + laser beam

CONCLUSION

Subsequent to laser beam hardening a decrease of microhardness is being noticed in both steel classes – fig.4.due to coagulation of carbonitrides. At the same time, in the case of microstructure research, a carbon diffusionwithin the piece may be noticed and this is due to the increase of the pearlite quantity in the proximity of thenitrocarburatecoating . The coating microhardness decreases but increases in the proximity of the nitrocarburatecoating

Table 1 and fig. 5 show that, after superficial laser beam melting of carbon steel for buildings, no increase ofcarbide and nitrite chemical compounds has been noticed; meanwhile, in the case of allied steel for buildings, asignificant increase of this coating is to be noticed. From a microhardness perspective – fig. 5 – laser beamthermal treatment applied on both steels, microhardness increases especially in the case of C 30.

The nitrocarbide area has a defined nonmetallicfeature, fact that reduces thepossibility of microweldings emergence onsurfaces in contact; this area ischaracterized by a low friction coefficientand by good lapping capacity.These features only emerge inside the ecombinations layer having oxynitrocarbidetraits. The alloying elements formingstable nitride increase the hardness of thediffusion layer and, implicitly, the liftingcapacity of the layer. Further on ispresented the comparison between thewear hardness of nitrocarbide layers andthe ones that are classically thermaltreatedAs shown by the experimentalresults, nitrocarburate layers demonstrate awear hardness which is definitely superiorto the classically thermal-treated samples.In the case of nitrocarburate layers, theexistence inside the e combination layer ofcertain punctiform pores does not affectthe hardness and the plasticity ofnitrocarbides area, or the cohesion with thediffusion layer. In exchange, it allows theimprovement of the surface lappingcapacity as a consequence of lubricantretention within the superficial poresblinded to the surface through channels.The optimal thickness of the combinationlayer with the best properties of wearhardness is of 10-20 µm. In the case ofreduced lifting loads it is advisable to havea combination layer obtained through aircooling due to the emergence of certain eoxynitrocarbides, of some combinations ofoxyde and nitride with good antiseizure andantiwear properties.

REFERENCES

Reference to a journal:

- Catana D., Thermomechanical Treatment Influence on the High-speed Steel Hardness and Wear, Universal Journal of Materials Science 3(3): 44-48, 2015
- Olàh A., I. Giacomelli – “Research regarding the influence of heat treatment upon nitrocarburatestructures”, International Conference – BRAMAT‘03, Braşov, 2007.

  Reference to a book
- Giacomelli I., Drugă L., Samoilă C., Bot D., - „Tehnologiineconvenţionale cu transformări de fază”, Ed. LuxLibris, Braşov, 2000.