EAN '97

35th International Conference on
Experimental Stress Analysis
June 4 - 6, 1997, Olomouc, Czech Republic

POWDER ALLOYING OF LOW CARBON STEEL BY CO_2 LASER

Chmelíčková H., Kucharičová L., Grézl J.

Alloying is one of several methods of surface treatment by laser beam. Results of this application is wear resistant, corrosion resistant and high temperature oxidation resistant coatings on substrates for instance low carbon steel. This method is based on the melting of the substrates surface and introducing of additional material. In range of co-operation with firm LASERTECH, ltd. Olomouc, we have made an experiment with low carbon steel 0,2%C and two powders : metal powder K 55 and ceramic powder SiC.
Results of the experiment are introduced and illustrated by graphs and photos.

Laser surface treatment is divided into several methods : transformation hardening, melting, alloying and cladding. Each of them is characterised by set of process parameters (power, diameter, transverse speed), which determine results of application. Laser alloying and cladding both need melting of component surface and introduction of additional material. This material can be in powder or solid form and can be preplaced or fed during melting process applied surface layer is usually 0.5 - 2.0 mm.

We made an experiment with specimen from low carbon steel 0,2% C and two kinds of powders : metal powder K 55 and ceramic powder SiC. The parameters of these powders are introduced in table 1. Powders were fed into a melting pool by means of a powder feeding tube of powder feeder TWIN Compact, that stand as near as possible by worktable of CO_2laser Control ltd. with maximum power 2500 W.

Process parameters remained constant for four values of transverse speed :

Power :	2 200 W
Beam diameter :	0.4 mm
Focal distance :	150 mm
Transverse speeds :	100, 400, 800, 1200 mm/min

We applied three trace with overlap 50% and one control trace for each speed. Alloying samples were than cut in YZ plane, ground and etched. Cross sections of affected zones were measured and documented by means of device NEOPHOT 2.

powder traces	**number of sample**	**width (mm)**	**high (mm)**
K 55 - 1 trace	2	4,4	3,6
	4	1,78	1,87
	6	1,35	1,61
	8	0,96	1,22
K 55 - 3 traces	1	8,61	4,01
	3	4,03	1,89
	5	2,59	2,25
	7	2,31	2
SiC - 1 trace	11	3,9	2,87
	13	2,36	2,16
	15	2,33	1,53
	17	1,13	1,88
SiC - 3 traces	10	8,8	2,93
	12	5,4	2,73
	14	3,14	2,47
	16	2,1	2,01

Table 1. : Dimensions of the affected zones

Vickers hardness test was made with test load 98,07 during time 10 s (10 Hv). Average values are :

specimen	116
trace K 55	383
trace SiC	336

We can see, that the hardness of surface layer increased three times. Transverse speed has also effect on quality of affected zone, that is non uniform for speeds less than 400 mm/min and insufficient for speed greater than 800 mm/min. The following photograph shows undesirable cracks in sample No.10, caused by the slow speed 100 mm/min.

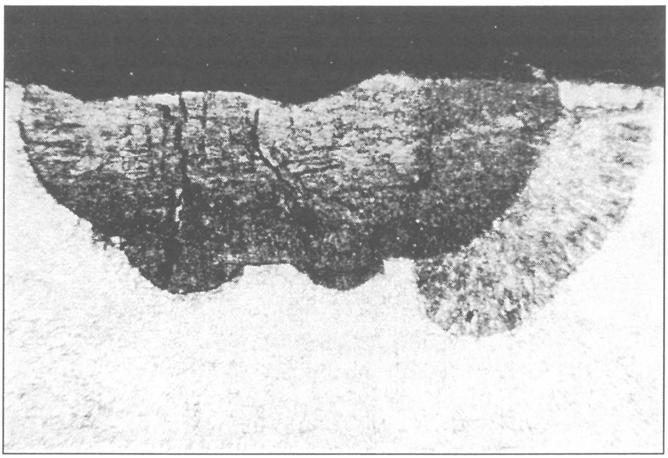
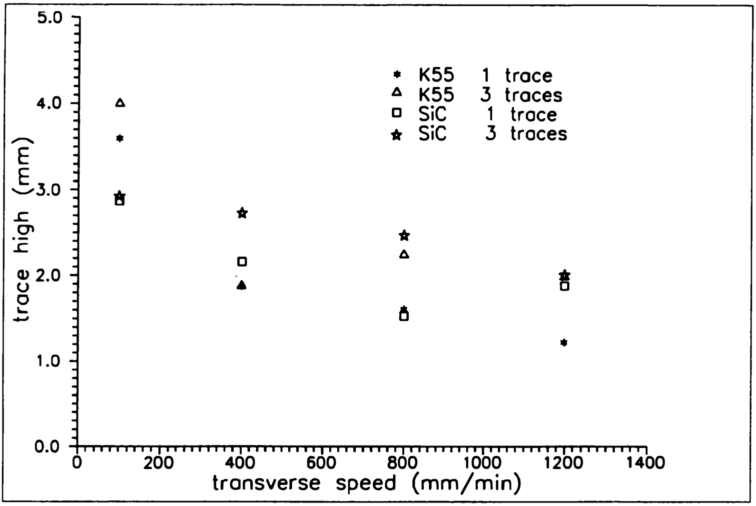


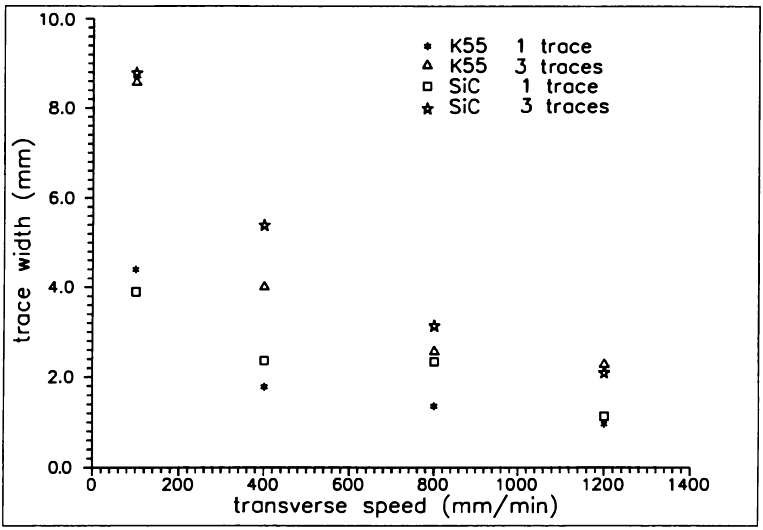
Fig. 1 : Cross section of sample No.10, magnified 15,6 x

There are photographs of four various samples on the figures 2. - 5. We can see different character of affected zones of three traces K 55 and SiC for speed 400mm/min (fig. 2 and 3). Fig.4 shows the uneven affected zone for the biggest speed 1200 mm/min, fig. 5 shows 12,5x magnified one trace of K 55 for the smallest speed 100 mm/min.

The conclusion of our work follows from the obtained results : experiment in smaller speed interval 400 - 800 mm/min will be made with more kinds of powder materials to gain optimal results.

The dependence of the dimensions of melted zone on transverse speed is illustrated in graphs No. 1 and No. 2. We can see that width and high both fall down with increasing speed.





Literature : 1. Wearasinghe, V.M. : Laser Cladding of Flat Plates, PhD thesis, University of London, December 1984

2. Craffer, R.C.,Oakley, P.J. : Process and Physical Aspects of Continuous Wave Laser Processing, International Course on Applied Laser Tooling, Vigo, Spain 1985

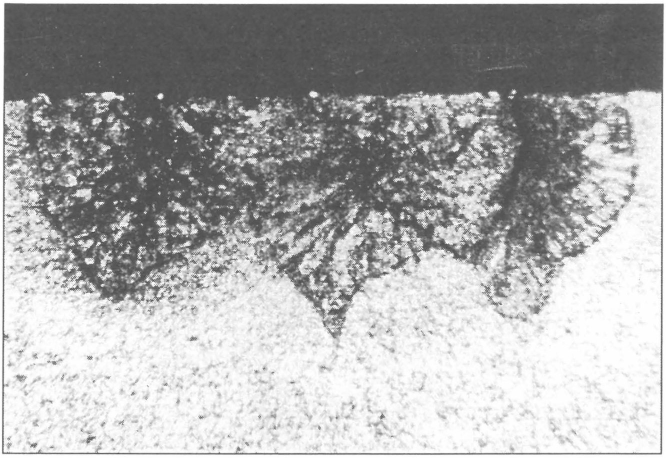


Fig. 2 : Sample No.3, K 55, v = 400mm/min, magnified 15,6x

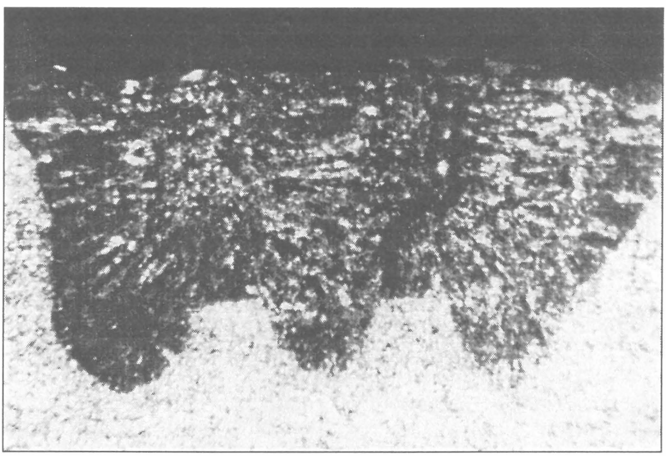


Fig. 3 : Sample No.12, SiC, v = 400 mm/min, magnified 15,6x

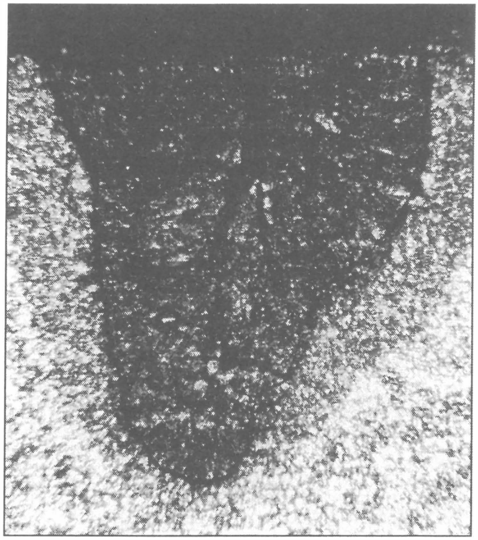


Fig. 4 : Sample No.7, K 55, v = 1200 mm/min, magnified 25x

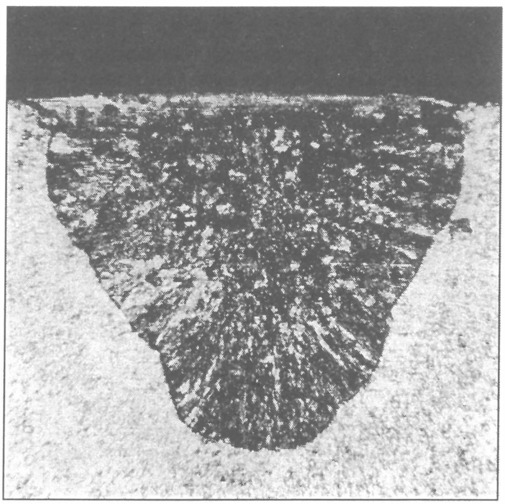


Fig. 5 : Sample No.2, v = 100 mm/min, magnified 12,5x

Hana Chmelíčková, RNDr.
SLO UP a FzÚ AVČR Olomouc, tř. 17. listopadu 50, 772 07 Olomouc
tel. 068-563 1516, e-mail : chmelh@risc.upol.cz