The 25th International Baltic Conference of

Engineering Materials & Tribology

November 3-4 Riga, LATVIA

ABSTRACTS BOOK

The Organizer:

The Latvian Materials Research Society

Title of Edition: Book of Abstracts of Baltmattrib 2016, 25th International Baltic Conference of Engineering Materials&Tribology

Publisher: The Latvian Materials Research Society

Print: RTU Digital Print Center

ISBN 978-9934-19-029-2

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Research of Laser Cladding of the Powder Materials for Die Repair

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INTRODUCTION

Laser cladding is the progressive alternative technology for the hardening and repair of the worn details of the dies, molds and machine details in comparison with conventional surface treatment [1, 2]. At that the tool steels are considered as hardly applicable for cladding due to high content of carbon and alloying elements [3]. Nevertheless some researches on the laser cladding of the tool steel are known, but the defectless coating was not achieved – the cracks were revealed [3, 4]. This work is devoted to the laser cladding of the powder materials with the object of the high stabile quality of the coating.

EXPERIMENTAL METHODS

Experimental part was carried out using industrial robot KR30HA (Kuka, Germany), cladding tool with coaxial powder supplying WT03 (Permanova Lasersystem, Sweden) and ytterbium fiber laser (IPG YRL 1000, power up to 1 kW). The powder materials (AISI: M2, A11, H13) were deposited on the different base materials: carbon steel (EN ISO 4957: C45U) and tool steel for cold working (EN ISO 4957: C80U). The influence of the overlapping of the deposited beads, as well as pre- and after heat treatment on the geometry, surface quality and tribological properties of the coating (hardness and friction coefficient) was investigated. The surface morphology was investigated with scanning electron microscope TESCAN-VEGA-LMU II (Tescan, Czech Republic). Chemical composition of samples was determined by X-ray spectrometry analysis (EDS module INCAx-act, Oxford Instruments, UK).

RESULTS AND DISCUSSION

The comprehensive investigation of the deposited beads was confirming the hypothesis about significance influence of the heat treatment on the quality of the coating in combination with the optimal parameters of cladding regime. Three different zones of the system coating-base material were examined: clad zone (CZ), interface zone (IZ) and heat-affected zone (HAZ). After the analysis of the microhardness profile it was revealed, that the microhardness decreases in following order: CZ, IZ, HAZ and base material. The deposited beads from the materials M2 and A11 have the highest microhardness values in the CZ. Besides it was established that with increasing of the overlapping of the deposited beads the coating thickness is increasing, but the weld penetration – decreasing that in turn leads to decreasing of the mixing of coating material with the base material. At minimal overlapping the maximal heat influence on the base material is revealed. In this case the HAZ is increasing and the tempering of martensite occurs – as a result, in the upper region the microhardness decreases.

CONCLUSION

High stabile quality of the coating of the tool steel during dies repair might be achieved within the optimal cladding regime and optimal ratio of the overlapping of the deposited beads as well as using heat pretreatment and after treatment of the samples. Appropriate recommendations for laser cladding of the tool steel were elaborated and offered.

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