Analysis of Microstructure and Properties of Multilayer Coatings Produced by Laser Cladding

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Nowadays, there is a growing interest of using additive technologies in the industry which also include laser cladding coatings – a complicated process, whose goal is to restore the damaged parts of surfaces, as well as giving them the required properties. Using a fiber laser allows to achieve the most concentrated source of energy and its high optical quality of the radiation, high power and the ability to transport laser radiation through the fiber lines significantly simplifies problem of creating a high-quality coating and improve the economic performance of the technology.

Study is carried out on the installation consisting of five main parts: the cell coordinate system Huffman HC 205, the computer system control, feeder for powders Sulzer Metco Twin 10-C, fiber laser LS-3.5 power up to 3.5 kW, chiller for cooling the laser and the optical head. We used a powder of the brand PR-10R6M5, the grain size of which is in the range up to 140 \(\mu\)m. Sieving through a flat sieve was performed for improving the properties of the cladding. The cell size varied from 63 to 100 \(\mu\)m. The powder became more homogeneous, without large teardrop-shaped beads after screening. Additionally, the substrate surface grinding of used steel 34HMA (iron content of \(\sim 98.54\%\)) was carried out for removal of oxides before the experiment.

Experiments showed that the most powerful influence on the width and depth of the cladded track has laser power variation, and height of the track – the powder feed rate. Following optimal mode of deposition track was selected with all of the above requirements: laser power is 400 W, linear speed of substrate is 37.5 cm/min, powder feed rate 1 g/min and a height above the surface of the nozzle 5 mm.

Initial gradual cladding in the above-mentioned regime and different overlap of 1/3W, 1/2W, 2/3W was carried out, where W is a width of one track. After a visual inspection and cross-sectional analysis, taking into account the uniformity of penetration of the track proved to be the most optimal layer applied with overlapping 2/3W.

Bilayer welding was produced in different conditions. First of all the first layer was created by means of gradual application of tracks with overlapping of 2/3. Then the second layer was fabricated under the same regime, but with the tracks direction different than in the first case: at an angle 0°, 45° and 90°. Penetration of the substrate was similar in all cases. Also the samples have the same iron content in the coating and equal microhardness but if the direction of the second cladding layer at an angle of 0°, this dependence is more homogeneous.