Formation of material structures with improved properties by laser irradiation using diffractive optics

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INTRODUCTION

The tasks of improving the aggregate physical and mechanical properties of materials represent one of the most current areas of research in order to further address important practical problems in a wide spectrum of industrial development areas. Through targeted modification of the structure of materials, it is possible to control their strength, hardness and elasticity, increase resistance to corrosion and reduce the amount of energy required for friction. Laser processing is used to carry out such advanced modification techniques.

DEVELOPMENT OF METHODS FOR THE FORMATION OF STRUCTURES IN MATERIALS BY LASER IRRADIATION

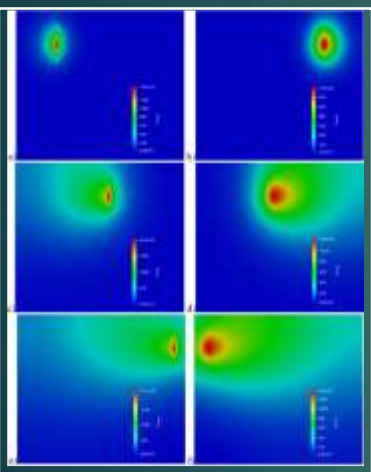

Fig.1. Temperature field on the front and back surface of the sample respectively. Distance from the beginning of the treatment path: 5 mm (a), (b); 15 mm (c), (d); 25 mm (e), (f)

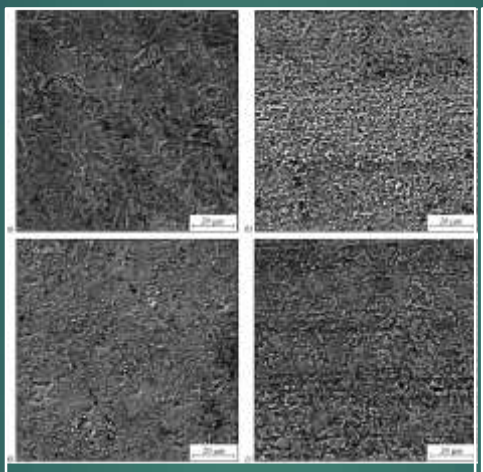

Fig.2. Scanning electron microscope images of the structure of the heat affected zone during treatment without melting of the surface of dual-phase steel: zones of complete (a) and incomplete hardening (b), annealing zone (c), the original structure (d).

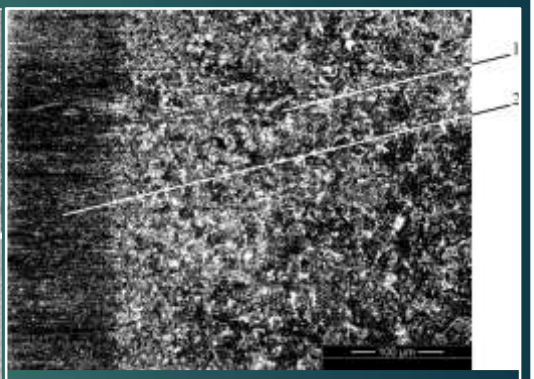

Fig.3. Structure of Ti-2Al-1.5Mn titanium alloy sheet as a result of laser annealing: 1 – annealing area, 2 – original structure.

As a result of the laser treatment with the use of diffractive optical elements, it was actually possible to increase the adhesion strength of coatings, which were applied to structural elements

The use of diffractive optics methods, technologies and devices to shape the laser beam has been found to achieve the desired characteristics in the materials to be treated.

CONCLUSION

The use of diffractive elements of computer optics makes it possible to obtain the required geometry of the material processing areas, which allows improving the quality of the laser processing. The possibilities for the formation of nanomaterials are considered and the synthesis of both nanoporous materials and composite nanomaterials based on zinc oxide are presented. The presented results make it possible to improve the processes of laser material processing, as well as to perform further research aimed at finding new approaches to the production of ordered structured materials. The material modification by a focused femtosecond laser beam is applicable to the formation of microstructures for optical purposes.

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