SUMMARY

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Title: **Effect of Arc and Laser Cladding Process Parameters on the Microstructure and Mechanical Properties of Protective Coatings for Turbine Blades Produced on a DS200+Hf Nickel-Based Superalloy**

This dissertation presents the results of investigations into the effect of the type of filler material and the parameters of TIG arc cladding and laser cladding processes on the weld bead geometry, microstructure, phase composition, and mechanical and functional properties of protective coatings produced on a DS200+Hf nickel-based superalloy substrate. The study focused on coatings manufactured using cobalt-based alloys Stellite 694 (Co-26Cr-19W-5Ni-0.85V-0.85C) and Tribaloy T-800 (Co-28Mo-18Cr-3.4Si), intended for the protection of contact surfaces of low-pressure turbine blade platforms operating under high-temperature fretting wear conditions.

The thesis assumed that replacing the arc cladding method (TIG) with laser cladding in the process of producing protective coatings on the DS200+Hf superalloy substrate would enable an increase in coating hardness and wear resistance under friction conditions. Control of thermal energy during the cladding process, through accurate selection of parameters such as laser power, beam diameter, cladding speed, and powder feed rate, allows for shaping the weld bead geometry, phase composition, microstructure, and protective properties of the deposited coating. It was also assumed that the Tribaloy T-800 alloy could serve as an alternative to Stellite 694 due to its similar chemical composition.

Within the scope of the study, the influence of laser cladding process parameters particularly laser power and beam diameter (power density), cladding speed, and powder feed rate on the geometric dimensions of a single weld bead and the degree of substrate remelting was analyzed. Laser cladding conditions for protective coatings produced using Stellite 694 and Tribaloy T-800 powders were established, comprising two sets of technological parameters: P1 - laser power 370 W, beam diameter 1.3 mm, and cladding speed 8.33 mm/s, and P2 - laser power 530 W, beam diameter 1.2 mm, and cladding speed 5 mm/s. These parameter sets were used to assess the influence of process conditions on weld bead geometry, microstructure, and the mechanical and functional properties of the deposited coatings.

Microscopic examinations and phase composition analyses revealed that coatings produced using the TIG method exhibit a more heterogeneous microstructure in the fusion boundary region, whereas laser cladding promotes the formation of a fine-grained and more homogeneous microstructure. In Stellite 694 coatings, a cobalt-based matrix with precipitates of M_6C and $M_{23}C_6$ carbides was identified, while in Tribaloy T-800 coatings the dominant constituents were hard intermetallic Laves phases (Co_3Mo_2Si).

Hardness measurements revealed variations in the hardness of the protective coatings depending on the filler material and the cladding technology used, with the highest values obtained for Tribaloy T-800 coatings produced by laser cladding.

Fretting wear resistance tests conducted at a temperature of 800 °C showed that the application of cobalt-based protective coatings leads to an improvement in tribological performance compared to the base material. The most stable fretting behavior was observed for Stellite 694 coatings produced by laser cladding, whereas Tribaloy T-800 coatings, despite exhibiting low coefficient of friction, showed higher variability in the wear mechanism.

Keywords: nickel-based superalloy, laser cladding, TIG cladding, microstructure, phase composition, hardness, fretting wear