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Short Communication

Surface hardening of commercially pure titanium by laser nitriding: Response surface analysis

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Abstract

In this work laser surface nitriding was performed to enhance wear and erosion resistance of pure titanium by increasing its surface hardness while keeping the strength and ductility of the core for static and dynamic loading resistance. The Response Surface Methodology (RSM) in the Design of Experiment (DOE) statistical method is adopted in this research work to perform the experimental design, analysis and optimization of the laser nitriding process. Continuous wave CO_2 laser was used to melt the surface, and then nitrogen gas was incorporated into the melted pool to produce hard TiN. The Response Surface Design was first created using MINTAB program, and then the laser nitriding process was performed according to the planned design. Microhardness is then measured for each

sample, which represents the response, and incorporated into the design matrix. Results are then analyzed and a RSM model was developed and verified. The model is then used to perform parametric study and optimization. The maximum measured microhardness based on the original RSM design was 1382 $HV_{0.15}$. However, based on the model prediction, the optimal process parameters settings were found to be as: 2.84 kW laser power, 5 mm/s scanning speed and 2076 l/h nitrogen flow rate which would result in a maximum microhardness of approximately 1920 H