Surface laser boronizing of maraging steel parts manufactured by selective laser melting

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Maraging steel (MSt) is known as a special class of high-strength steels with the specific alloying system providing highly alloyed low-carbon iron-nickel lath martensite matrix, which is aged (annealed) to obtain hardening by intermetallic precipitation. Recently, this steel has been increasingly used in the field of additive manufacturing because it has high resistance to thermal cracking and can be used in the production of parts by selective laser melting. Despite the yield strength of MSt reaches high values (up to ~2420 MPa for commercial grades), it has moderate hardness (~58 HRC max.) and, as a result, insufficient wear resistance under severe working conditions. In the present study, the surface laser alloying process is investigated as a possible way to improve wear resistance of MSt parts. The samples manufactured by the SLM method and heat treated at 840 (2 h) and 490 (2 h) degrees were coated with a layer of amorphous boron 0.03-0.6 mm thick and processed with a laser beam at different laser speeds (500-1500 mm/min), providing a treatment in a melting mode. The alloying process was performed with the preheating the samples to 400 degrees. Boronized layers in a wide range of hardness from 490 to 2200 HK0.2 with a structure from hypo-eutectic to a mixture of borides were obtained. The effect of the thickness of pre-placed boron paste layer and laser speed on the molten pool geometry and formation of boronized layer was investigated. The nature of cracks formed was studied as well. The hardness distribution along the layers depth and the influence of processing parameters on the softening effect and thickness of the heat affected zone were studied. Two-body dry sliding wear test was conducted to assess their wear resistance. All boronized samples showed an improvement in wear resistance (on average up to ~7.5 times), with the exception of samples having the lowest hardness ~ 490 HK0.2.