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Surface and profile morphology analysis in austenitic stainless steel F138 after shot peening and plasma nitriding surface treatment

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Besides austenitic stainless steel being used in surgical implants due to its low cost, good corrosion resistance, and biocompatibility, it may have low fatigue and tribological properties. Therefore, such materials can be subjected to some surface treatments, such as plasma nitriding and shot peening. The objective of the present work was to analyze the influence of shot peening pretreatment on the surface morphology and layer profile of plasma nitride ASTM F138 stainless steel at low temperatures and long periods and its influence on the fatigue properties of the material. The material was subjected to shot peening, using stainless steel shots between 0.30 and 0.08 mm and 15 s of treatment time. After it was followed by plasma nitriding at low temperatures of 380 °C and a period of 16 h. Low temperatures in plasma nitriding treatments occur in order to avoid reducing corrosion resistance. The material was characterized by X-ray diffraction, identifying the formation of iron nitrides and expanded austenite. The morphology and microstructure were analyzed by scanning electron microscopy (SEM), focused ion beam (FIB), and confocal laser scanning microscopy, which was also used to determine surface roughness. The nitrided layer formed after shot peening shows the formation of microcracks and a decrease in surface roughness. Previous shot peening treatment to plasma nitriding promotes the formation of a less homogeneous layer. Throughout microscopy analysis was found the formation of a deformed region with a thickness of approximately 7 ?m, composed of a thin region of variable thickness, between 2 ?m and 0.1 ?m, with microstructure indicative of grain refinement, followed by a region with defects such as discordances and twins, induced by shot peening. As the concentration of plasma nitriding treatment nitrogen increases, the presence of defects increases, suggesting an increase in surface roughness.