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Uniaxial deformation effect on the fatigue-corrosion resistance of the ISO 5832-1 stainless steel for biomaterials application

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Plastic deformation processes modify the material fatigue-life behavior. The combination of this effect with the presence of a corrosive environment affects the material fatigue-corrosion behavior through changes in the surface material condition by slip bands creation and the interaction with surface inclusions and corrosive medium. It is expected that different directions of uniaxial deformation have different effects on the corrosion-fatigue behavior of the material once the extent of surface interactions are different in each case. In this study, the effect of uniaxial deformation direction on the fatigue-corrosion resistance of the ISO 5832-1 stainless steel, bone plate material used in orthopedic surgery, has been investigated. Specimens were submitted to, either, compression plastic deformation or tensile plastic deformation and then the corrosion-fatigue behavior was evaluated. The fatigue-corrosion tests were carried out under a flux of the corrosive environments, either deionized water or 0.9 wt% NaCl solution. Specimens as received (without uniaxial deformation) were also submitted to fatigue-corrosion test for comparison reasons. The results did not show a significant effect of the corrosion environment on the fatigue test since similar results were obtained in both environments used. The compression plastic deformation decreased the fatigue life in comparison to the tensile plastic deformation, but both, compression, and tensile plastic deformation increased the fatigue life comparatively to the as-received material suggesting a beneficial effect of the deformation on the fatigue properties of the studied material.

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