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Effect of cold deformation on corrosion fatigue behavior of nickel-free high nitrogen austenitic stainless steel for coronary stent application

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Abstract Due to the excellent mechanical properties, good corrosion resistance, high biocompatibility and nickel-free character, the high nitrogen nickel-free austenitic stainless steel (HNASS) becomes an ideally alternative material for coronary stents. Stent implantation works in harsh blood environment after a balloon dilatation, i.e., the material is used in a corrosive environment with a permanent deformation. The present study attempts to investigate effects of pre-straining on high-cycle fatigue behavior and corrosion fatigue behavior of HNASS in Hank's solution and the relevant mechanism for coronary stents application. It is found that higher pre-straining on HNASS results in higher strength and maintains almost same corrosion resistance. Fatigue limit of 0% HNASS is 550 MPa, while corrosion fatigue limit is 475 MPa. And improvement in fatigue limit of 20% and 35% pre-strained HNASS is in comparison with the 0% HNASS, while corrosion would undermine the fatigue behavior of HNASS. In a suitable range, the pre-straining had a beneficial effect on corrosion fatigue strength of HNASS, such as nearly 300 MPa improved with 20% cold deformation. This result provides a good reference for predicting the life of HNASS stent and as well its design.

Key words: Cold deformation; High nitrogen austenitic stainless steel; High-cycle fatigue; Corrosion fatigue