ABSTRACT

Present study primarily focuses on the in-vitro mechanical properties of ferrous and non-ferrous materials under the influence of various corrosive atmosphere. A systematic study to evaluate the properties, including the microstructure, corrosion resistance, phase analysis, biocompatibility, etc. are extensively covered. Steel wire exposed to saline atmosphere and undergo failure has been considered for the present study. An optimized pre-immersion time in the saline atmosphere enhance the fatigue and corrosion behavior of materials, however, the monotonic properties deteriorates with increasing immersion time.

In-vitro mechanical behavior of pseudoelastic *NiTi* wire in Ringer's lactate and simulated body fluid modifies the fatigue strength of the *NiTi* alloys. Mean stress have adverse impact on the fatigue behavior i.e. increasing mean stress significantly reduces the fatigue strength. In-vitro fatigue behavior of *NiTi* wire in Ringer's lactate and simulated body fluid shows an adverse effect on fatigue behavior of *NiTi* alloys whereas, the monotonic tensile behavior reveals nominal change in tensile properties. Corrosion behavior shows higher corrosion resistance for simulated body fluid due to its lesser corrosive nature of the solutions. Higher corrosive nature of Ringer's lactate facilitates to improve the fatigue performance by forming a thick corrosion product over the surface of the wire which in result delays the crack initiation process.

Further to estimate the influence of bio-fluids on the mechanical performance of *NiTi*, macroscale in-vitro mechanical behavior is also conducted. Tension-compression incremental fatigue is used to evaluate the fatigue performance. A fully reversible strain recovery is observed in air, Ringer's lactate and simulated body fluid indicated the excellent pseudoelasticity even in bio-fluids 1.2% strain used for strain control fatigue in Ringer's lactate and simulated body fluid suggest lower fatigue life in simulated body fluid. Thinner surface product in simulated body fluid ruptures easily and provide a fresh preferential site for crack initiation and thus serve lesser life as compared to Ringer's lactate.

Understanding on the pseudoelastic behavior of *NiTi* is further extended to the materials manufactured with advance manufacturing technique. Additively manufactured *NiTi* with optimum laser energy density developed optimized microstructure and mechanical properties. Specimen designated as *NiTi_E2* having optimized laser energy density (40 J/mm^2) shows moderate porosity level and hence excellent tensile and pseudoelastic behavior. Digital Image Correlation used for evaluation of strain distribution in the specimen validates the better strain recovery for *NiTi_E2*.

Keywords: In-vitro fatigue, bio-fluids, pseudoelasticity, incremental fatigue.