

Duplex Stainless Steel in Biomedical Applications



Abstract

Duplex Stainless Steel (DSS) is defined as SS with a pitting resistance equivalent (PRE) value above 40. The DSS has localized corrosion resistance that is as good as the titanium alloys, because its passive film is enhanced by the synergistic effect of high concentrations of nitrogen and molybdenum. It also has high mechanical properties due to a solution strengthening effect. It is thought that these properties allow the material to minimize the amount of nickel ions released in the oral environment. Moreover, the corrosion characteristics of DSS (i.e. 2205) were demonstrated to be better than those of austenitic stainless steel (i.e. 316L) in artificial saliva. Even their toughness is higher than that of the ferritic steels but slightly lower than the austenitic ones. DSS are characterized by a structure consisting of approximately equal amounts of ferrite and austenite. Because of its high mechanical and corrosion resistance, austenitic stainless steel has been replaced with austenitic-ferritic stainless steel in several industrial applications that require better resistance to stress-corrosion cracking. Results in the literatures also shows that the biocompatibility of austenitic and austenitic-ferritic steel is similar. In the case of orthodontic treatments, the replacement of austenitic stainless steel with austenitic- ferritic steel reduces costs and nickel hypersensitivity to patients. The DSS showed in the literatures has very high localized corrosion resistance in the orthopedic devices, like harrington rods for the treatment of the scoliosis and sliding-compression plate-screw systems and can be considered not susceptible to crevice corrosion in the human body; it has higher mechanical properties than those of the today used austenitic stainless steel; in particular, very high fatigue resistance can be reached. In the literature survey, the good behavior in vitro of the (SAF 2507) DSS has been confirmed both by in vivo investigation on animals, and by the clinical experiences that have been performed.

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Biography

Ali Sabea Hammood is in metallurgical engineering-corrosion engineering and surface protection from university of technology in 2004. He was trained in Instron company-London-UK about mechanical testing of materials in 1990. From 2007 to 2014 he worked as the head of department of materials engineering at faculty of engineering-university of kufa. From 2016 to 2020 he worked as head of biomedical materials engineering(BMME) track at the same university. He has authored for five scientific books in english by international and national publishers, and 44 scientific articles published in international and national journals, peer-reviewed for highly accredited scientific journals. He has supervised 5 PhD. Projects and 9 M.Sc. Dissertations. as well as having a patent about using duplex stainless steel (2507) as a new material in orthodontic wires.



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