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Electrochemical Behavior of Some Biomedical Alloys in Simulated Physiological Solutions

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ABSTRACT

In this work the electrochemical behaviors of Fe-Cr-xNi with different nickel content (x=4, 8, 10, 14), as biomedical material, were investigated in simulated body fluid with, without albumin addition and in simulated inflammation solution. Typical electrochemical techniques such as open-circuit potential (OCP), Potentiodynamic polarization measurements and electrochemical impedance spectroscopy (EIS) were used. Atomic absorption spectrophotometer (AAS) were utilized to assess the differences in corrosion products and ions released induced by SBF with and without albumin and inflammatory system. SEM-EDX analyses are used to analyze the surface morphology and the constituent of the surface component of alloys. The results have shown that the corrosion rate and corrosion resistance of alloys material are found to depend on the Ni/Fe ratio in the bulk alloy and Cr/Fe oxides ratio on the surface oxide. The effects of alloying element were also studied in simulated solution for 168 h. The results show that corrosion rate, corrosion current density and passive film resistance depend mainly on Ni presence. As the Ni % increase and Fe% decrease the corrosion rate and current density decrease. The effects of immersion time have been studied for 168h in three medium and the result show excessive effect of albumin presence and also inflammation condition in the passive film resistance and corrosion rate. However existence of albumin raises the corrosion rate and reduces the passive film resistance owing to metal complexation but also the alloy with highest Nickel content (14%) shows higher passivity and lower corrosion rate. Addition of H_2O_2 to SBF with albumin increase the corrosion rate, total concentration of released metal and decrease the passive film resistance and alloys with Ni content lower than 10% show passive film failure under inflammation condition. After study of all alloys in the three medium concluding that the stability of those alloys in s imulated body fluid depend on Ni% and the resistance increase by increasing Ni content and the Cr/Fe oxide ratio in passive film .the EIS data were fitted to corresponding equivalent circuit that explain different processes occurred at electrode/electrolyte interface.