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The influence of the composition of Ni and Cr in the resistance to the corrosion of Ni-Cr-Mo alloys for dental prosthesis in NaF 0,05% solution.

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Abstract – Ni-Cr alloys introduced in early years at odontology have disclosed to compete in mechanical properties with those of noble metals, for manufacturating of partial or full dental structures. Fluoride Compounds are frequently usual as prophylactic products in dental treatments but the fluoride ion cause corrosion in non-noble metals. This study reports the behavior of three alloys with different chemical compositions in naturally aerated NaF 0,01 M at 37°.C, pH 6,0 using different electrochemical methods. Beryllium -free Ni-Cr alloys with Cr higher (near 20%) contents led to a higher stable passive surface.

Ni-Cr alloys introduced in early years at odontology have disclosed to compete in properties with noble metals, for manufacturating of partial or full dental structures [1]. Keeping in view the fact that the implants alloys are exposed to aggressive conditions in the mouth/oral cavity, it is felt that corrosion studies of these alloys in aggressive medium will provide wealth of information about the alloy/metal to be used under dental applications. The high corrosion resistance of Ni-Cr alloys in various tests solutions such as saliva and other physiological media is due to the formation of a very protective oxide layer on its surface [2]. NaF and other fluoride compounds are frequently used as prophylactic products in dental treatments to prevent plaque formation and caries development. Fluorides are inimical to all reactive metals such as Titanium, especially in acidic media, causing corrosion due to destruction of their passivity and loss of mechanical properties [3]. This fact motivated a deeper study in influence of the chemical alloy composition on corrosion resistance of Ni-Cr-Mo alloy, which is the aim of this paper. This study reports the behavior of three alloys named A, B, C in naturally aerated NaF 0,01 M at 37°.C, pH 6,0 using different electrochemical methods. The composition of the alloys are: A (Ni-73%Cr-14%Mo-8,5%Be-1,8%Al-1,8%),B(Ni-61%Cr-25%Mo-10,5%Si-1,5%) and C (Ni-65%Cr-22,5%Mo-9,5%). Figure 1 shows the variations of Open Circuit Potential (OCP) with time. The alloys B and C show the potential changes in the positive directions until the steady-state potential is reached, indicating the formation of protective layer. The potential drifts slowly to the negative side for the alloy A, indicating a slowly dissolution. Potentiodynamic Anodic Polarization curves performed after OCP measurements are shown Figure 2. It can be seen in the case of alloys B and C presents' passivation interval of 600 mV and passive chain density 10^{-6} A/cm2. The alloy with the highest composition of Nickel and the least composition of chromium don't passivate in the medium studied showing a continuous increase of the chain density in function of the increase of the potential It can be seen from Cyclic Voltamogram studies (Fig. 3) that on reversing the potential it takes a more current path indicating the less stability of surface film. In addiction this alloy present a lower breakdown potential in comparison with Be-free alloys. The results show that different chemical composition of Ni-Cr alloys play a important role in corrosion resistance at near neutral fluoridated solutions. Care must taken during long treatments with fluoride containing prophylactic products in the vicinity of the Ni-Cr dental material with Beryllium content and composed of near Cr (14%).

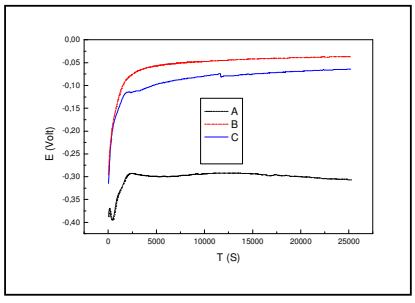

Figure 1: Open Circuit Potential against Time Plot of alloys A, B and C immersed in NaF 0,01M

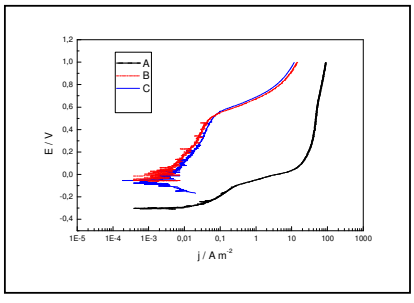

Figure 2: Anodic polarization curves after OCP experiments of A,B and C alloys in NaF 0.01 M

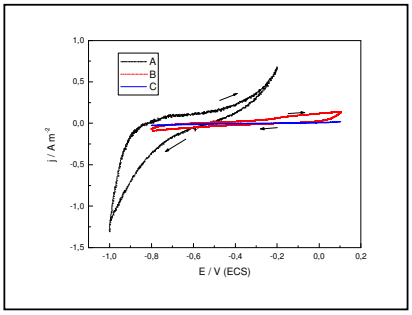

Figure 3: Ciclic Potentiodynamic Polarization curves of the A,B and C alloys in NaF 0,01 M

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