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Preliminary study of physical characteristics of different Ti alloys for future electrochemical surface treatment

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Biomedical devices can respond of different ways when in contact to the biological environment. As energy surface has been demonstrated influence the corrosion, adhesion, and cell proliferation, since that this free energy can be increase or decrease the surface wettability and then the chemical and biological properties. In order to improve biological, as well as tribological properties, electrochemical surface treatments (i.e., anodization and/or plasma electrolytic oxidation) can be done. Coating homogeneity are closely related to the bulk microstructure. In this sense, different alloys, with different phase composition, grain size (GS) and grain boundaries (GB) may influence these properties. In this work Ti-15Nb (alpha' martensite, Moeq=4.2), Ti-34Nb-6Sn (beta, Moeq=11.32) and Ti-33Nb-33Zr (beta, Moeq=21.12) were studied. Samples were fabricated using an arc furnace integrated into the suction system and was remelted and inverted at least 8 times to ensure homogeneity; an arc-voltaic furnace with water cooled copper, both systems with controlled argon atmosphere. For phase characterization as well as the lattice parameters, X-ray diffraction (XRD) was applied. Cu Kalpha radiation of 1.541 Å was used, which works at 40 kV and 20 mA. The XRD measurement was taken within the 20–90 deg range with a 0.02º step every 10 s. Phases and diffraction planes were analyzed by comparing the d value of each peak of the diffraction pattern from those of the Inorganic Crystal Structure Database (ICSD). The microstructure of samples was characterized by Scanning electron Microscopy with backscattered electrons (BSE), secondary electrons (SE) and X-ray energy dispersive detectors (EDS). Then, the wettability was performed by contact angle of the water droplets on the surface. The results indicated the lattice parameter associated with stabilization of beta phase was a= 0.33139 nm for Ti-15Nb; a= 0.33754 nm for Ti-34Nb-6Sn and a= 0.33862 nm for Ti-33Nb-33Zr. The cross section of the samples was characterized by different microstructural regions. Microstructure formed in Ti-15Nb indicated the presence of acicular martensite structure formed by coarse grains. The Ti-34Nb-6Sn alloy was formed mainly by beta-Ti phase. For the Ti-33Nb-33Zr alloy presented two different regions formed by dendritic microstructure (beta-Ti) and matrix formed by beta-Ti. The GB of Ti-15Nb was thicker than Ti-34Nb-6Sn also the GS, showed be higher compared to the Ti-15Nb. The relation of the contact angle was: TNS < Ti-Nb-Zr < Ti-15Nb. It can be seen that different content and type of beta stabilizer are associated with different microstructure properties. These alloys with different sizes and thicknesses grain as well as different phase compositions are expected to respond in a unique way to different surface treatment.