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Tribocorrosion behavior of Ti-10Nb alloy for biomaterial applications

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Ti and Ti6Al4V alloy are widely used to replace hard tissues due to their higher biocompatibility, corrosion resistance and suitable mechanical properties. There is a concernment about the long-term release of harmful ions, as aluminum and vanadium by dissolution from the Ti6Al4V alloy. These metals have a poor wear performance, and higher coefficient of friction that restrict to the applications in the biomedical area. Besides, wear debris can result in inflammatory reactions that cause pain and the loss of implants by osteolysis. In order to replace these materials, new beta alloys composed by non-toxic elements, as Nb, Ta, Mo, have been proposed, which are corrosion resistant and have mechanical properties suitable for biomaterials applications. After implantation into bone, implants can be exposed to tribocorrosion conditions, i.e., process combined of corrosion and wear. However, research about the tribocorrosion behavior of new beta Ti alloys is still very limited. In this study, tribocorrosion properties pure Ti and Ti-10Nb alloy for biomedical applications in phosphate-buffered saline solution were investigated. The tests were done by reciprocating tribometer against Al2O3 ball, electrochemical tests and scanning electron microscope images. The results, during the sliding, of open circuit potential demonstrated that the Ti-10Nb alloy was more resistance to corrosion than pure Ti. The coefficients of friction obtained were 0.48 and 0.57 to Ti-10Nb alloy and Ti, respectively. These metals showed a similar wear rate (~0.66 10^{-3} mm^3/Nm). The images of worn tracks revealed abrasive, adhesive and oxidative wear for all samples. The results disclosed that the coefficient of friction was influenced through microstructure of Ti-10Nb alloy. Neither mechanics of wear nor wear rate were dependent on the material microstructure. Therefore, in comparing to pure Ti, the addition of beta stabilizer element in the Ti-10Nb alloy improves the corrosion resistance and the coefficient of friction.

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