Abstract
It has been performed an electrochemical study of two titanium alloys employed in the manufacture of orthopedic implants, Ti6Al4V and Ti6Al7Nb, obtained through powder metallurgy (PM). For comparison purposes, conventional Ti6Al4V has also been investigated. Samples were immersed in a simulated body fluid and incubated at 37°C for different times. Under these experimental conditions, it has been compared the influence of the processing method of alloys (PM or conventional) and their composition in the corrosion resistance. Reproducibility and corrosion resistance of these alloys were evaluated by mean of electrochemical impedance spectroscopy (EIS). All of them showed good reproducibility and high impedance modulus value approximately on the order of 10⁶ Ω. Although no significant differences in the evolution of the corrosion behavior for different immersion times has been found; the Ti-6Al-7Nb PM delivers a steady growth of corrosion resistance from day one until twelve weeks immersion; showing the best performance between the two studied compositions. By mean of scanning electron microscopy, no evidence of pitting corrosion phenomenon was observed.

Motivation

![Process diagram](image)

Corrosion Resistance:

- Ti-6Al-4V (F)
- Ti-6Al-4V (PM)
- Ti-6Al-7Nb (PM)

Processing method Composition

Results

- Evolution of three alloys along the immersion time:
  - Ti-6Al-4V (F)
  - Ti-6Al-4V (PM)
  - Ti-6Al-7Nb (PM)

- Equivalent electrical circuit & corrosion mechanism:
  - Good visual fit
  - Results with physical meaning
  - Errors < 5%
  - Chi-squared = 8x10⁻³

- Three alloys comparison for a certain immersion time:
  - Ti-6Al-4V (F)
  - Ti-6Al-4V (PM)
  - Ti-6Al-7Nb (PM)

Conclusions

- The three studied alloys: Ti6Al4V (F), Ti6Al4V (PM) y Ti6Al7Nb (PM) show excellent corrosion resistance (|z|>10⁶Ω) in physiological conditions from day one until twelve weeks immersion.

- Although no significant differences in the evolution of the corrosion behavior, for different immersion times it has been found; the Ti-6Al-7Nb alloy processed by PM delivers a steady growth of corrosion resistance from day one until twelve weeks immersion: showing the best behavior between the three alloys.

- It has been shown how powder metallurgy allows obtaining materials with similar or superior corrosion resistance in physiological conditions than alloys obtained conventionally.

- MSC viability of cells grown on Ti6Al4V (PM) and Ti6Al7Nb (PM) alloys is similar to the conventional Ti6Al4V alloy.

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