Analysis of novel Ti15Mo7ZrxSi titanium alloys experimentally developed as potential materials for medical uses

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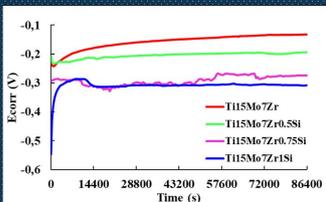
PURPOSE

The aim of this study is to examine the biocompatibility and mechanical properties of two innovative titanium alloys, Ti15Mo7ZrxSi (x = 0, 0.5, 0.75, 1). Electrochemical, metallographic, and three-point bending tests were carried out to determine the corrosion behavior, microstructure, and Young's modulus of the samples studied.
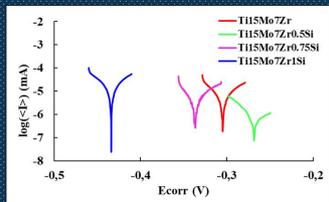
Samples	Ti (%)	Mo (%)	Zr (%)	Si (%)
TiMoZr	78.00	15.00	7.00	-
TiMoZrSi0.5	77.50	15.00	7.00	0.50
TiMoZrSi0.75	77.25	15.00	7.00	0.75
TiMoZrSi1	77.00	15.00	7.00	1.00

MATERIALS AND METHODS

Ti, Mo, Zr, Si — VAR — Ingots — Embedded — Ti15Mo7Zr0.75Si, Ti15Mo7Zr1Si — Cut — Grinding and polishing — Metallography — Electrochemical tests — Three-point bending
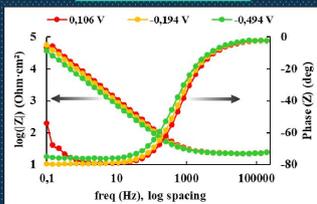
ELECTROCHEMICAL TESTS

CORROSION POTENTIAL

CORROSION RATE

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Ti15Mo7Zr

Ti15Mo7Zr0.5Si

Ti15Mo7Zr0.75Si

Ti15Mo7Zr1Si

METALLOGRAPHY TEST

Ti15Mo7Zr	Ti15Mo7Zr0.5Si

Ti15Mo7Zr0.75Si	Ti15Mo7Zr1Si

THREE-POINT BENDING TEST

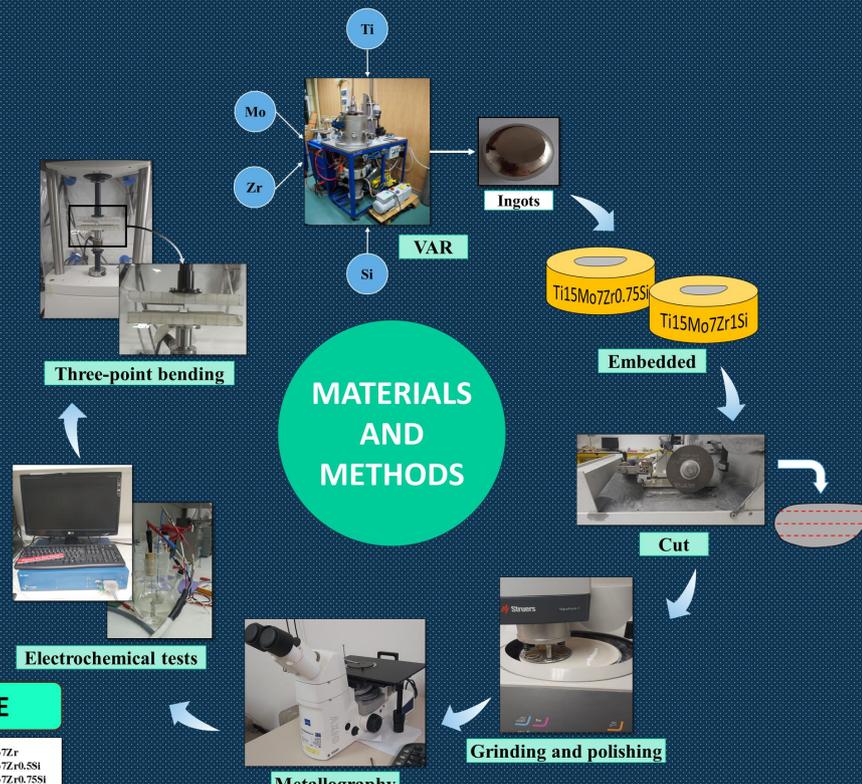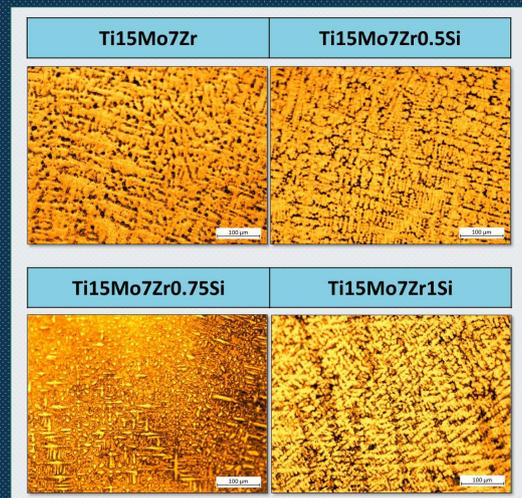| Samples	TiMoZr	Ti15Mo7ZrSi0.5	Ti15Mo7ZrSi0.75	Ti15Mo7ZrSi1
Young's modulus (Gpa)	82.4 ± 9.2	61.5 ± 8.4	66.0 ± 8.0	73.4 ± 8.2
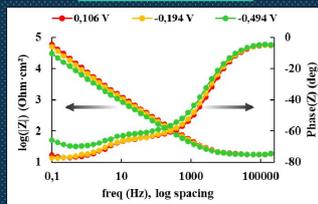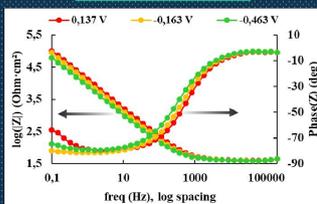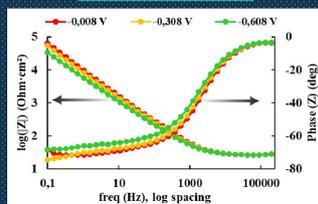
CONCLUSIONS

The study samples Ti15Mo7Zr0.5Si and Ti15Mo7Zr0.75Si have shown high corrosion potentials, lower corrosion rates and thus higher corrosion resistance, as well as modulus of elasticity values similar and closer to those of human bone. In conclusion, the evidence from this study suggests that both alloys show good corrosion behavior, high biocompatibility and modulus of elasticity values lower than those of commercial alloys used in biomedical implants.