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Development of Metal Matrix Composites based on Titanium Alloys

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Introduction

Titanium matrix composites are an alternative to improve the wear resistance and surface hardness of titanium alloys, while maintaining their high strength-to-weight ratio and excellent corrosion resistance. Among the processing methods, powder metallurgy is the most suitable technique for ex-situ processing, preserving the integrity of the ceramic reinforcement. Titanium carbide (TiC) is one of the most promising discontinuous reinforcements, providing high hardness and wear resistance

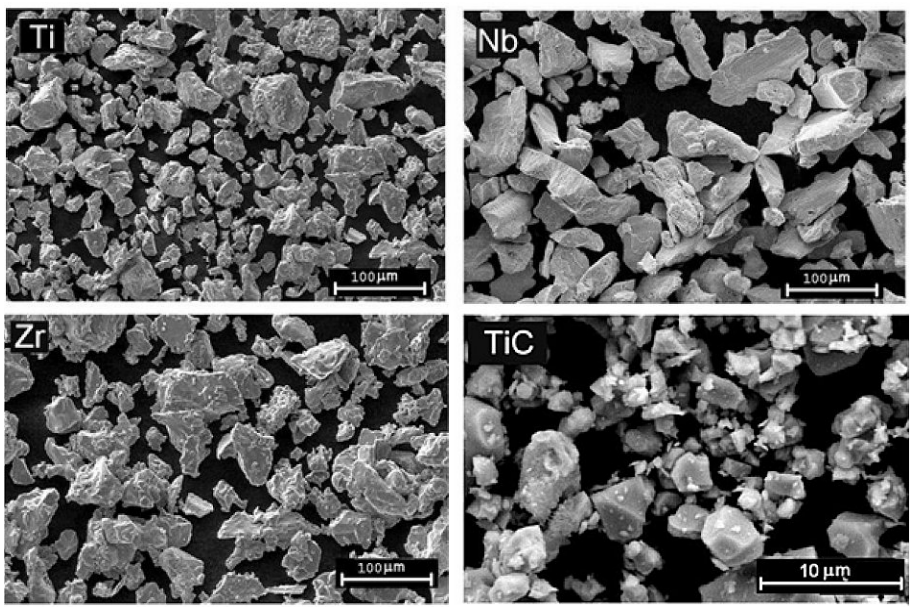
Objectives

This study investigates the influence of the addition of TiC (5% vol) in the Ti-13Nb-13Zr alloy matrix, analyzing its microstructure and optimizing hardness for aerospace and implant applications

Methodology

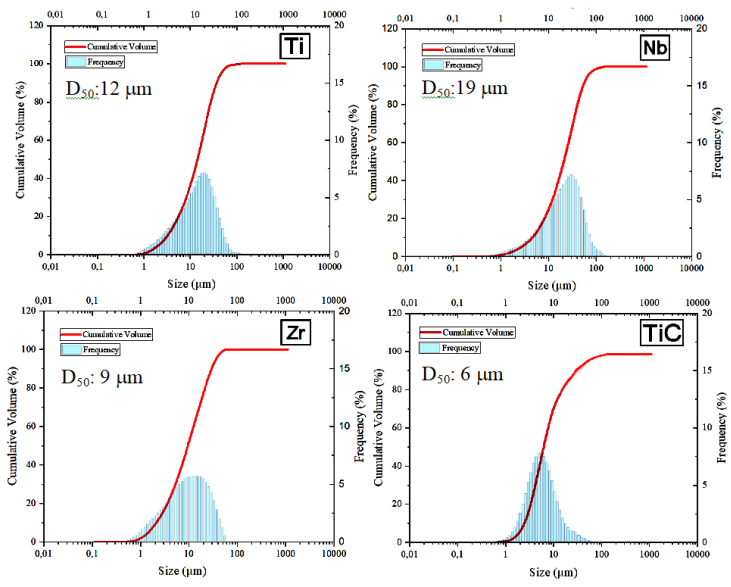
The Ti, Nb, and Zr powders were produced by hydriding between 500°C - 800°C. The TiC powders were supplied by Starck. The composites samples were produced from the mixing of the elemental powders, followed by uniaxial and cold isostatic pressing, with sintering (900°C-1400°C) at high vacuum (10^{-5} Torr). The samples were characterized by means of particle size, density, X-ray diffraction (DRX), scanning electron microscopy (SEM) and microhardness analyses

Powder morphology

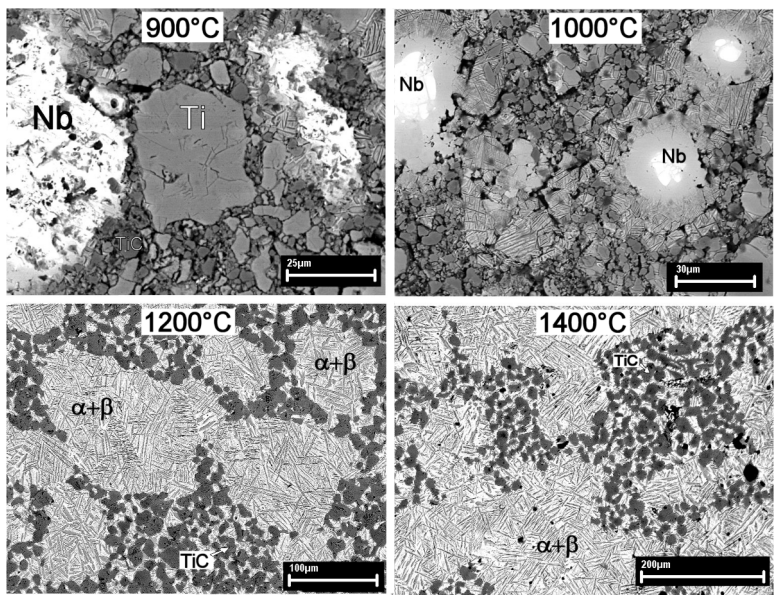


Results & Discussion

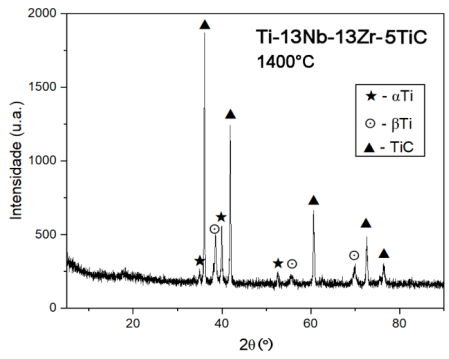
Particle Size Distribution



Sintering



Characterization



Sintering at 1400°C	Ti-13Nb-13Zr	Ti-13Nb-13Zr-5TiC
Hardness	340 ± 8,2 HV	420 ± 5,4 HV
Density	4.80 g/cm³	4.77 g/cm³
Densification	95.5%	94.5%

Conclusions

The microstructure at 1400°C shows TiC particles dispersed among large areas with Ti-13Nb-13Zr alloy matrix from the dissolution of Nb-rich regions. TiC areas are homogeneously mixed with α+β regions. The addition of 5% TiC increased hardness by 23%, enabling the use of the Ti-13Nb-13Zr alloy in applications subject to friction and wear

Aknowledgments and References

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