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Production of Titanium Alloys Parts by Metal Injection Molding

André Kenzo Sano Henriques[1]; Adriana Medeiros Gama[2]; Vinicius André Rodrigues Henriques[2]

1. Universidade Federal de São Paulo 2. Instituto de Aeronáutica e Espaço (IAE/DCTA)

Introduction

Metal Injection Molding (MIM) is an efficient technique for manufacturing parts with complex geometries, not fully mastered in Brazil, especially in feedstock production. This technique is promising for the mass production of titanium parts, mainly for the aerospace and defense sectors. In a typical MIM process, metal powders are mixed with a binder to form a feedstock that will be injected by specific machines. There is no mastery of the technique for manufacturing titanium-based feedstock in Brazil, with industries in the sector dependent on imports

Objectives

This work aims to develop a feedstock based in Ti-35Nb alloy and a wax-polymer/EVA binder system mixed under rheological conditions, suitable for the perfect filling of the injection mold cavities aiming the production of parts with a homogeneous microstructure and high densification

Methodology



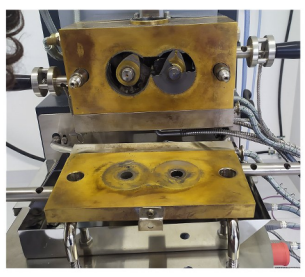
Hydriding
Ti-500°C
Nb-800°C



Ti-35Nb



Binder: PW-50%
EVA-35% SA-5%



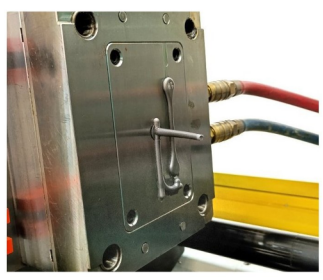
Torque rheometry
120°C - 60 RPM



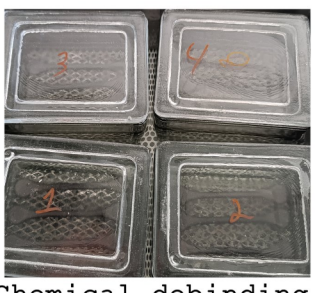
High shear
mixing



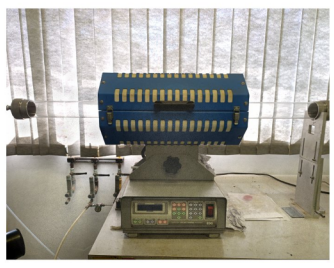
pelletizing



Injection
120°C - 85 MPa



Chemical debinding
Hexane- 40°C - 12h



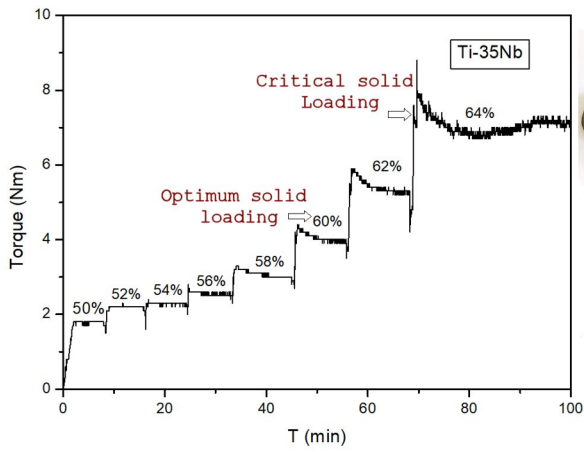
Thermal debinding
500°C/1h - 5°C/min



Sintering
1500°C/1h 10-5 Torr

Results & Discussion

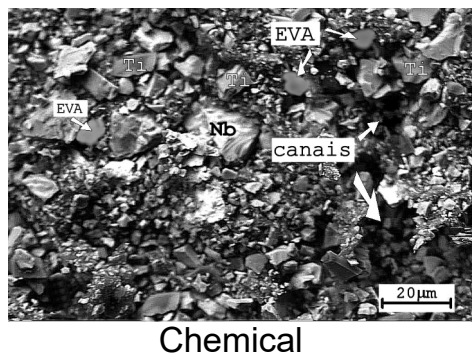
Torque Rheometry and Injection



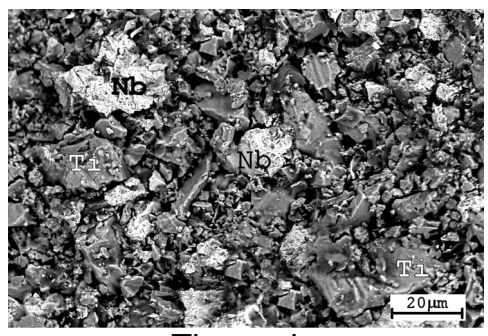




Debinding

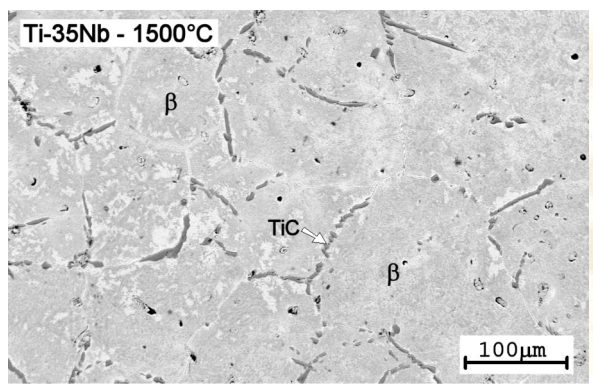


Chemical



Thermal

Sintering





Hardness and Densification

Net-shape as-sintered parts show superior hardness values (300HV) and high densification (97%)

Conclusions

Injection molded of Ti-35Nb feedstocks based on wax-polymer/EVA binder appears as a cost-effective alternative for manufacturing of lightweight strong parts for aerospace and defense industry. Hydrided powders has proven to be an attractive alternative for the MIM processing of titanium parts due to their high shrinkage during sintering and low cost. The variation in weight of green and sintered parts is less than 0.4% and the linear shrinkage after sintering is about 21%

Aknowledgments and References

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