EFFECT OF NB CONTENT ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF TI-NB ALLOYS FABRICATED BY POWDER METALLURGY

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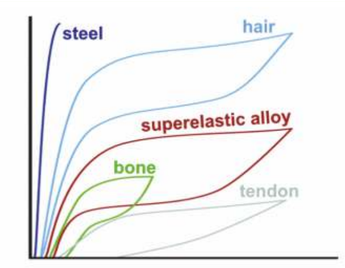
INTRODUCTION

Ti-Nb superelastic alloys:

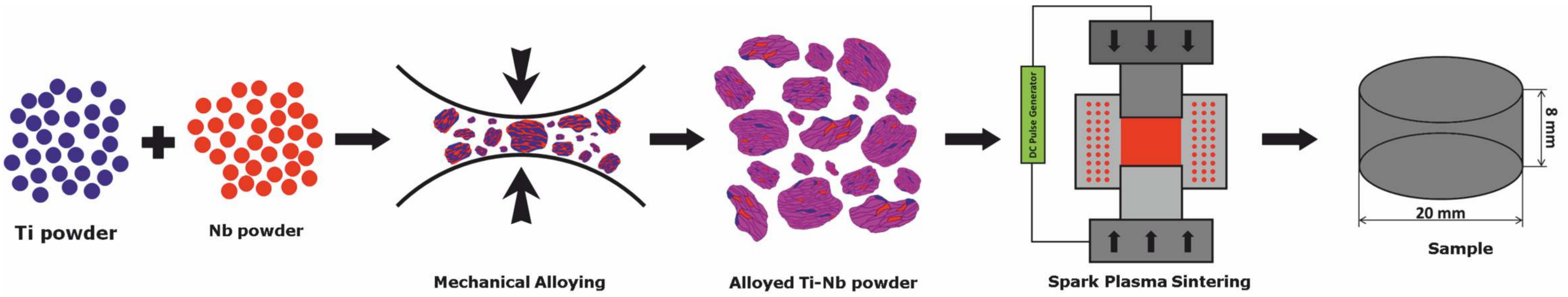
- Excellent biocompatibility (replacement for Ni-Ti alloys)
- Low Young Modulus (50-100 Gpa)
- Good superelastic behaviour – up to 5% recoverable strain
- Reverse thermoelastic martensitic transformation:
  β (BCC) → α″ (orthorhombic)



AIM OF THE WORK

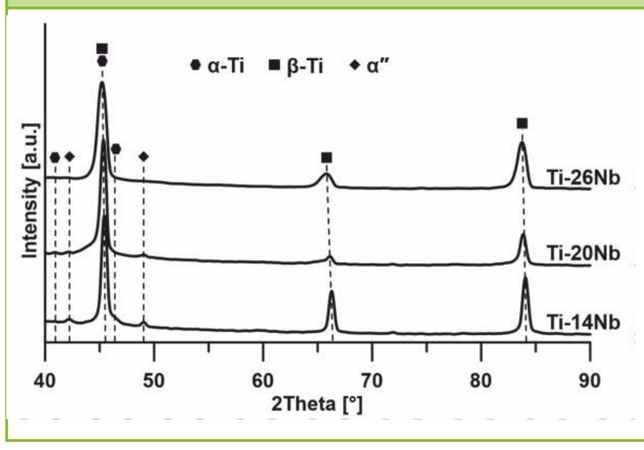
The aim of the work was to analyse the influence of Nb content on the microstructure, mechanical properties and superelasticity of Ti-Nb alloys fabricated using mechanical alloying and spark plasma sintering

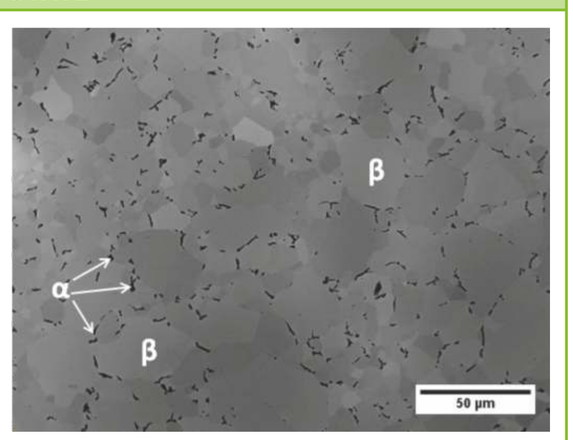
EXPERIMENTAL



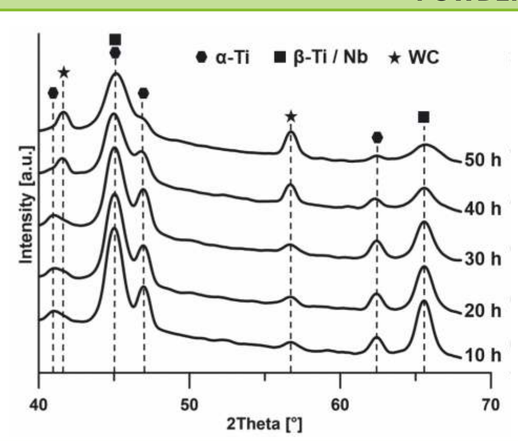
RESULTS

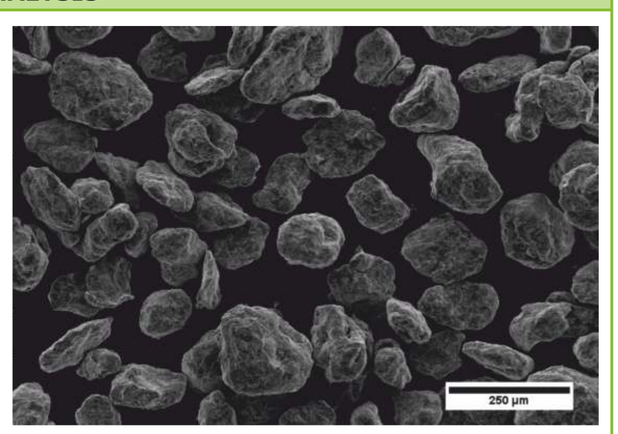
AS-SINTERED STATE



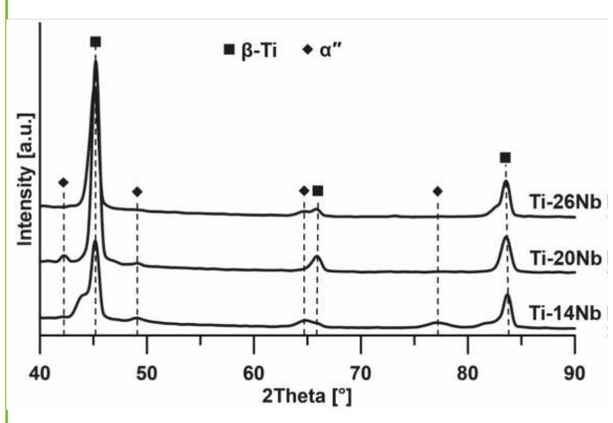


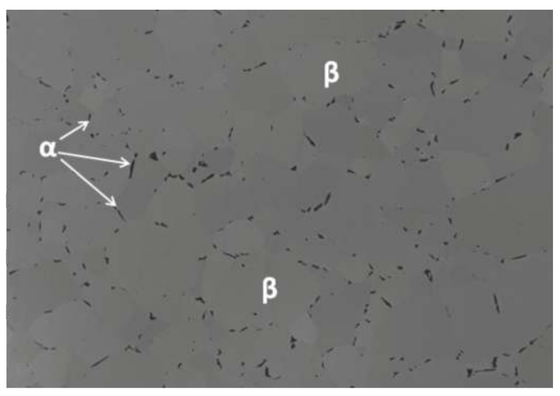
POWDER ANALYSIS

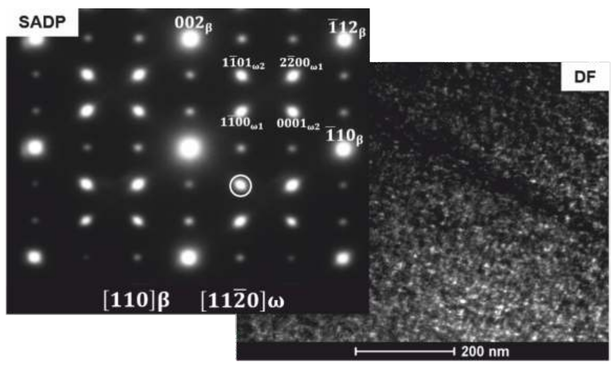


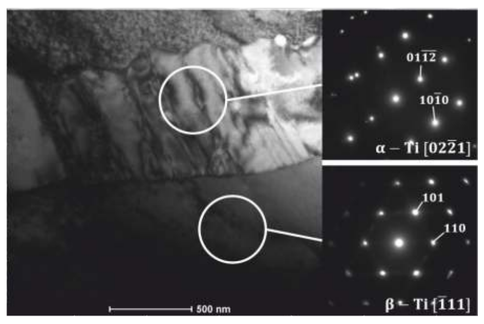


HEAT-TREATED STATE (1250°C/24h)









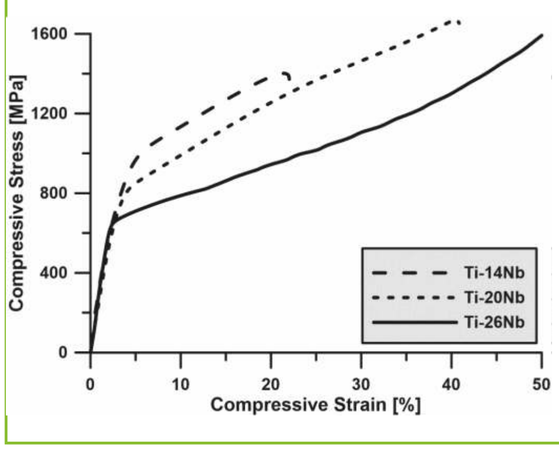
Effect of heat treatment on the microstructure:

α-phase content [vol.%]			
	Ti-14Nb	Ti-20Nb	Ti-26Nb
AS	2.6	2.0	0.9
HT	0.5	0.7	0.6

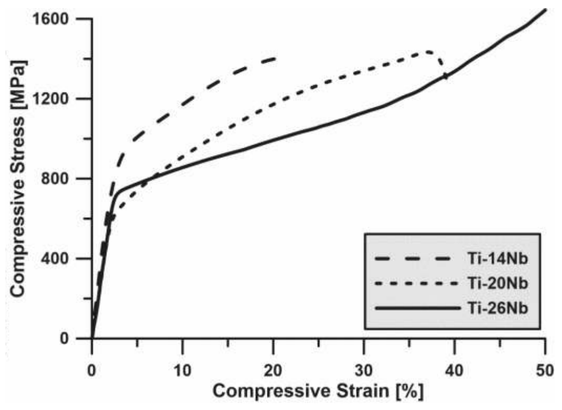
Nb content in ß-phase [at.%]			
	Ti-14Nb	Ti-20Nb	Ti-26Nb
AS	13.3	18.6	25.2
HT	14.8	20.5	26.7

MECHANICAL PROPERTIES

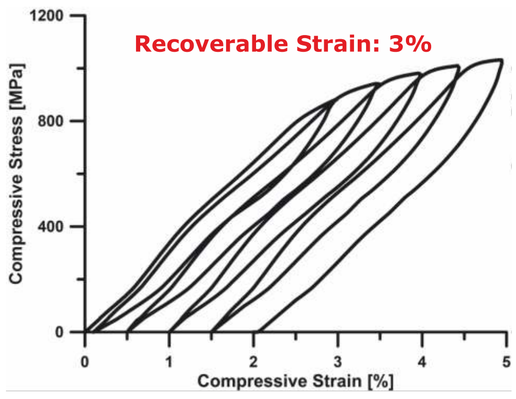
AS-SINTERED



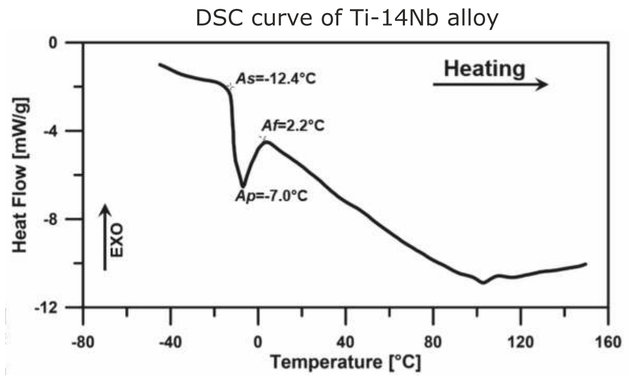
HEAT-TREATED



SUPERELASTIC BEHAVIOR OF Ti-14Nb



DSC curve of Ti-14Nb alloy



CONCLUSIONS

- Applied heat treatment conditions (1250°C/24h) lead to the reduction of α-phase content to about 0.5 vol.% in the case of all materials. The α-phase is observed as precipitations on β-phase grain boundaries.
- Yield Strength of as-sintered alloys decrease with Nb content and plasticity increase as a result of decreasing amount of hexagonal α-phase with increasing Nb content. Heat treatment has no significant effect on mechanical properties of the alloys.
- Superelastic properties at RT was observed for heat-treated Ti-14Nb alloy. This alloy exhibited maximum recoverable strain of 3%. Determined by DSC As and Af temperatures for the alloy were -12.4°C and 2.2°C, respectively.

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