Microstructural and Mechanical Properties of Near α-Titanium with Solid-Solution Elements by Powder Metallurgy Process

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Introduction

Titanium is one of the promising materials to be used as medical devices due to its excellent biocompatibility. The conventional Ti alloys, however, contain expensive rare metals such as vanadium, molybdenum and niobium to improve the mechanical properties. Some of them have a toxicity to human bodies, and then it is necessary to develop high-strength Ti materials with no rare metal. In this study, high strength and ductility near α-Ti material with solid-solute oxygen or nitrogen atoms was fabricated in solid-state by powder metallurgy (PM) process. This is because both have a large solubility in α-Ti phase. Microstructural and mechanical properties were evaluated, and their strengthening mechanism was clarified by using Labusch model useful for the quantitative evaluation of solid solution strengthening effects.

Material design and fabrication of high-toughened PM titanium

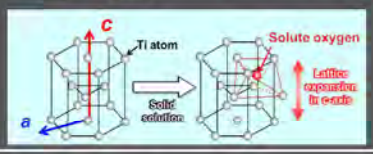
Rare-Metal-Free & Excellent Performance

Conventional extruded pure Ti powder material

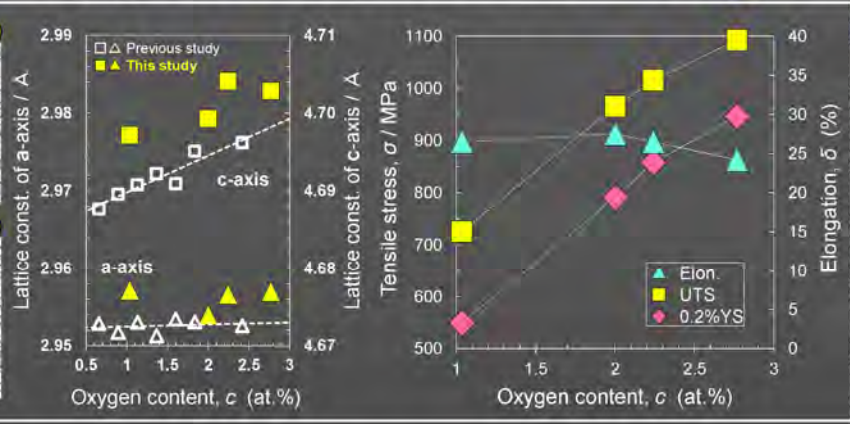
- Coarse grain
- Low contents of solute oxygen

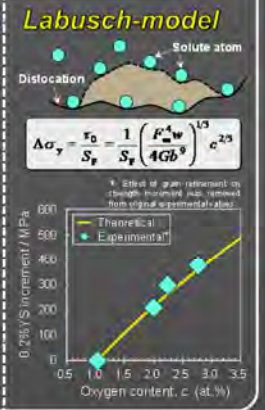
Titanium grain refinement

Solute high content oxygen

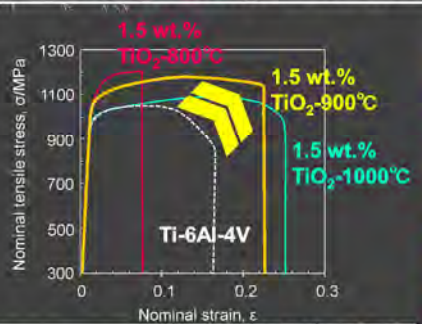


Microstructure and mechanical properties of extruded PM titanium with oxygen solid solution





High toughening titanium by grain refinement and oxygen solid solution



Samples	0.2%YS MPa	UTS MPa	Elongation (%)
1.5 wt.%TiO_2-800℃	908	1203	7.9
1.5wt.%TiO_2-900℃	**990**	**1158**	**23.9**
1.5wt.%TiO_2-1000℃	947	1093	24.2
Ti-6Al-4V (ASTMB 348-00-Gr5)	918	1047	16.6