

# Ti-47Al-2Cr

\*

<sup>1</sup> دانش آموخته کارشناسی ارشد مهندسی متالورژی و مواد - پردیس دانشکده‌های فنی - دانشگاه تهران

<sup>2</sup> دانشیار دانشکده مهندسی متالورژی و مواد - پردیس دانشکده‌های فنی - دانشگاه تهران

<sup>3</sup> دانش آموخته کارشناسی مهندسی متالورژی و مواد - پردیس دانشکده‌های فنی - دانشگاه تهران

<sup>4</sup> استاد دانشکده مهندسی متالورژی و مواد - پردیس دانشکده‌های فنی - دانشگاه تهران

(تاریخ دریافت ۸۵/۱۱/۷ ، تاریخ دریافت روایت اصلاح شده ۸۶/۸/۵ ، تاریخ تصویب ۸۶/۹/۲۰)

## چکیده

$\gamma$ -TiAl

$T_{\alpha}$

CCT

(massive)

- TiAl :

## مقدمه

) Ti-Al ( )

$\alpha$

)  $\beta$  ( )

)  $\gamma$  (

[ ]

( $\alpha$ )  $\alpha$  (

TiAl

[ ]

%

°C

[ ]

[ ]

[ - ]

[ ]

°C

°C

( °C)

°C

[ - ]

( °C)

86% $H_2O$ +6% $HNO_3$ +8% $HF$

Zeiss

Camscan

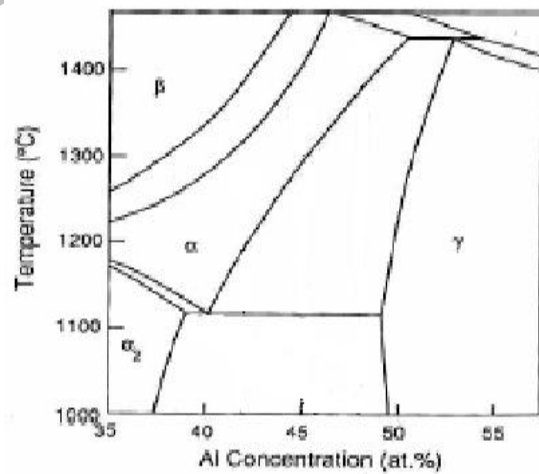
Philips X

EDX

نتایج و بحث  
ساختار ریختگی

( )

Ti-47Al-2Cr



[ ] Ti-Al

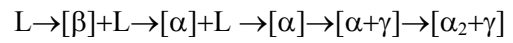
مواد و روش تحقیق

Ti-47Al-2Cr

( )

$\alpha_2$   $\gamma$

( ) Ti-Al



$\gamma \quad \alpha$

$\gamma + \alpha$

$\alpha$

$\gamma$

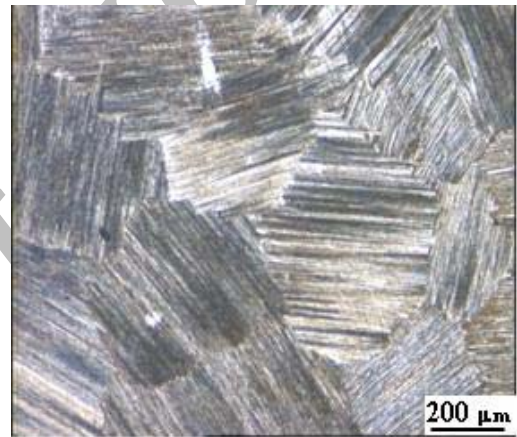
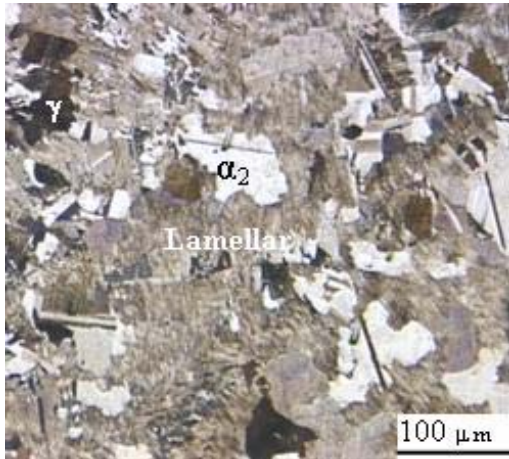
$\gamma$

$\alpha$

$\alpha_2$

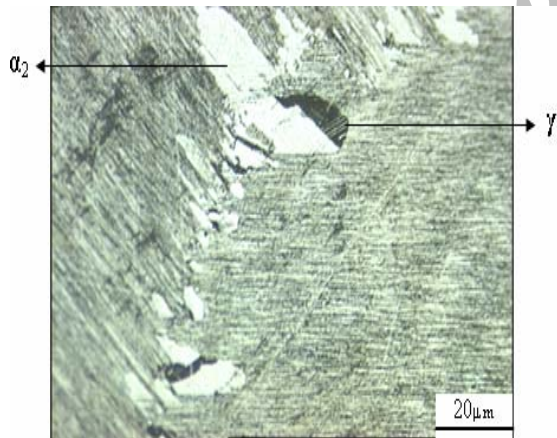
$\alpha$

[ - ]



شکل ۲: تصویر میکروسکوپی نوری از ساختار ریختگی آلیاژ Ti-47Al-2Cr در ناحیه هم محور.

ساختار آلیاژ همگن سازی شده



$\gamma \quad \alpha$

) °C

$\gamma \quad \alpha$

(

( )

$\gamma \quad \alpha$

$\alpha$

( )

$\gamma$

( )

$\alpha$

$\gamma$

$\gamma \quad \alpha$

$$D = kt^n \quad (1)$$

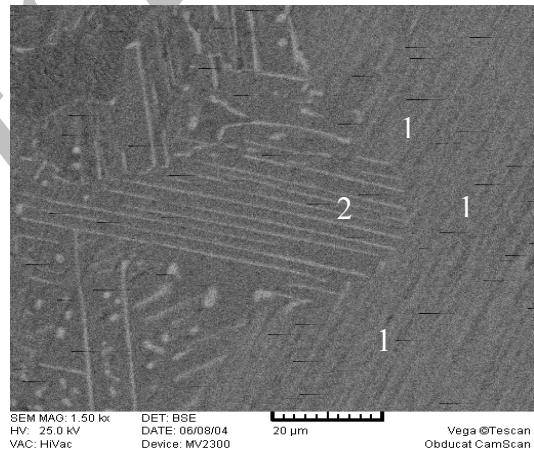
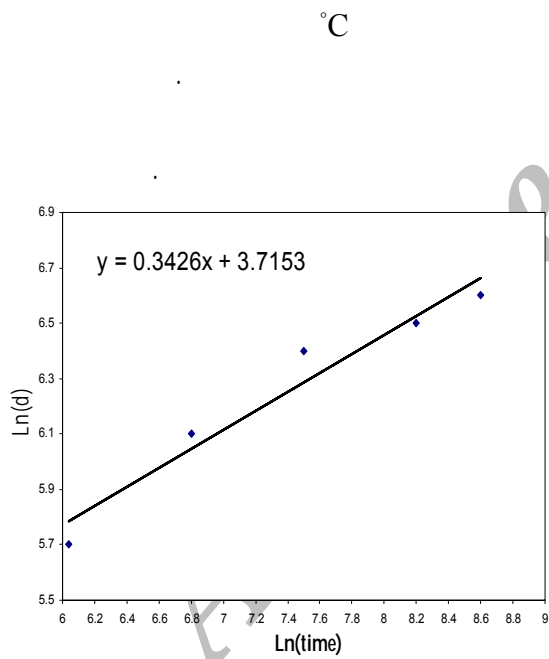
$$n = 1 \quad k = \mu\text{m/s}^{0.34}$$

EDX

(1)

$$T_\alpha \quad \alpha \quad ^\circ\text{C}$$

EDX



شکل ۵: تصویر SEM ریزساختار نمونه همگن سازی شده که نشان می دهد یک دانه نانویه (2) در حال پیشروی در داخل دانه لایه ای بزرگ اولیه (1) با مکانیزم رشد غیر پیوسته است.

عملیات حرارتی در ناحیه تک فاز  $\alpha$

$T_\alpha$

$\alpha$

CCT

$^\circ\text{C}$

(  $^\circ\text{C}$  )

(  $^\circ\text{C}$  )

$\alpha$

$$D=kt^n$$

$\gamma_m$

$\alpha$

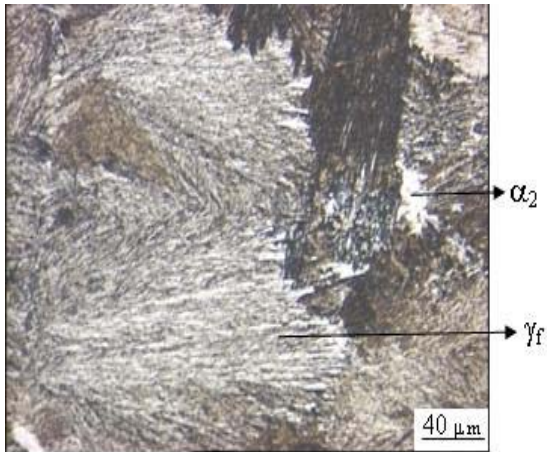
$\gamma_m$   
 $\gamma_m$

$\gamma$   
( )  $\alpha$   
( )  $\gamma_f$

$\alpha$

$\gamma_f$

$\alpha$   $\gamma_f$   
 $\gamma_f$



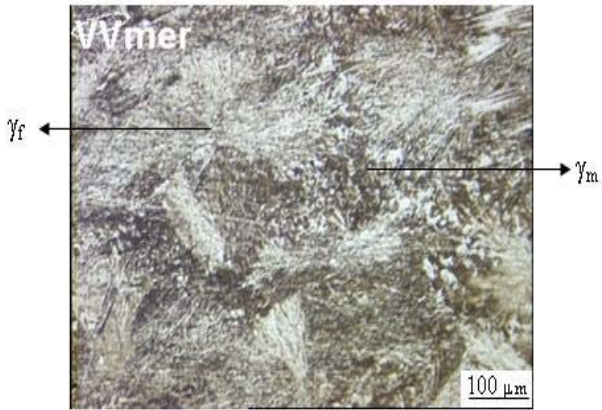
$T_\alpha$

$\gamma_f$

( )  $(\gamma_m)$   $(\gamma_f)$   
 $\gamma_m$   $\gamma_f$   $\alpha$

EDX

$\gamma_f$   $\gamma_m$   $\alpha$



$\alpha$   $\gamma_m$   $\gamma_f$

$\gamma_m$

( )

$\gamma_f$

$\alpha \rightarrow \gamma_m$

( )

$\gamma_m$   $\gamma_f$

$T_\alpha$

( )

[ ]

$(\gamma_m)$

$\gamma_m$

$\alpha$

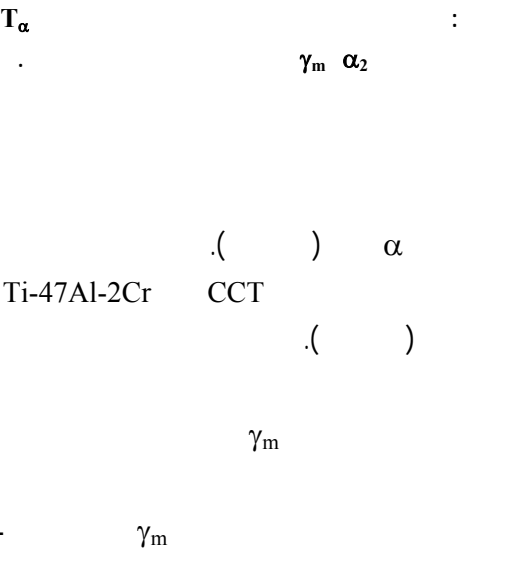
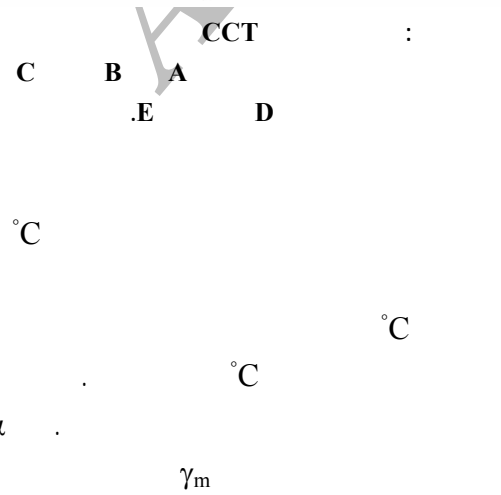
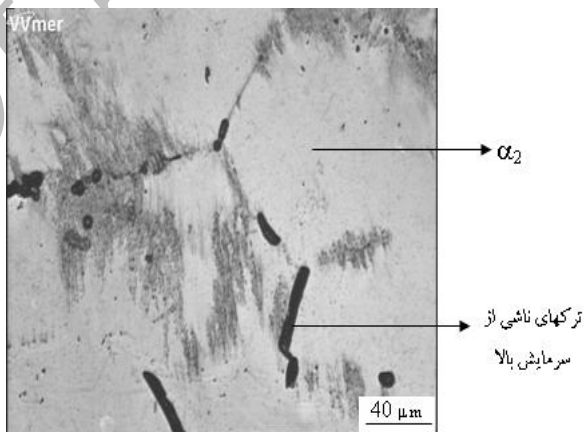
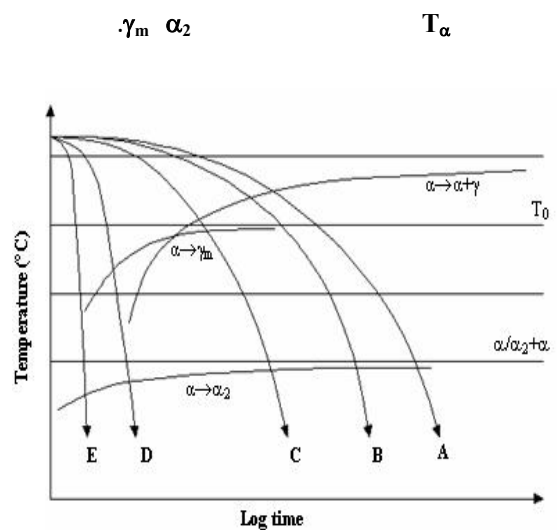
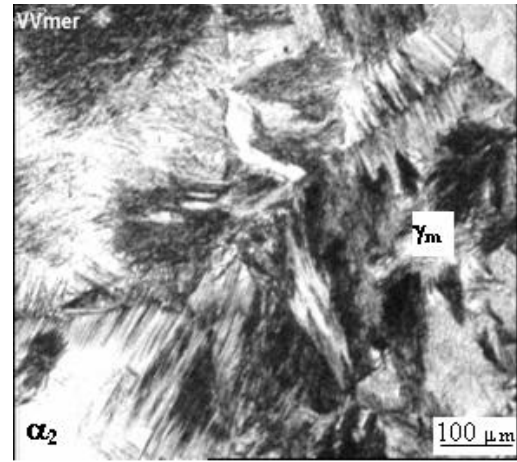
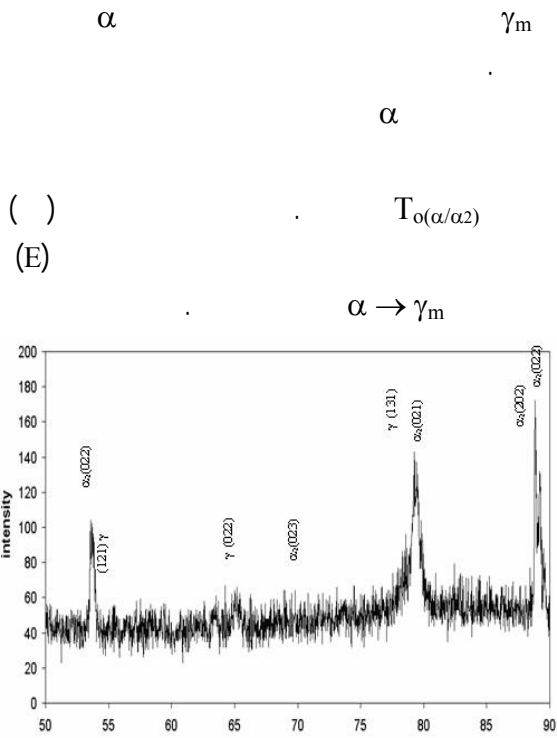
$\gamma_m$

( )

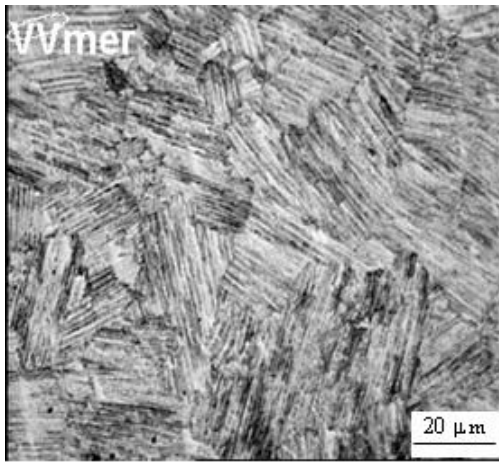
$\gamma_m$

$\alpha$

$\gamma_m$



( )



$\alpha$   $T_\alpha$   
 $[\ ]$   $\gamma_m$   
 $\alpha$

$(\gamma/\alpha)\alpha$

$[\ ]$   $\alpha$



**نتیجه گیری**

Ti-47Al-2Cr

$\gamma$   $\alpha$

$^\circ\text{C}$

$\gamma_m \rightarrow \alpha$

{ }

$\gamma$

$T_\alpha$

$\alpha$   $\gamma$

$\gamma$  { }

( )

$\alpha$

$\gamma$

$\gamma$

$\alpha$

$\alpha_2$

$\gamma_m$

$\alpha$

$\gamma_m$

$\alpha$

**تقدیر و تشکر**

بدینوسیله از قطب مواد با کارایی بالا بدلیل

حمایت مالی جهت انجام این پروژه قدردانی می‌گردد.



- 1 - Kim, Y-W. (1989). "Intermetallic alloys based on Gamma Titanium Aluminide." *J. of Metals, Minerals and Materials*, Vol. 41, PP. 24-30.
- 2 - Huang, S. C. and Chesternutt, J. (2003). "TiAl and its alloys." *Intermetallic Compounds Principal and Practice*, Vol. 2, Edited by J. H. Westbrook and R. L. Fleischer, PP. 73-90.
- 3 - Huang, S.C. and Hall, E. L. (1991). "The effects of Cr additions to binary TiAl base alloys." *J. of Metallurgical and material transaction A*, Vol. 22A, PP. 2619-2627.
- 4 - Semiatin, S. L. and Seetharaman, V. (1996). "Influence of temperature transients on the hot workability of a two-phase gamma titanium aluminide alloy." *Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science*, Vol. 27A, No. 7, PP. 1987-2004.
- 5 - Yang, J., Wang, J. N., Wang, Y. and Xia, Q. (2003). "Refining grain size of a TiAl alloy by cyclic heat treatment through discontinuous coarsening." *Intermetallics*, Vol. 11, PP. 971-974.
- 6 - Novoselova, T., Malinov, S. and Sha, W. (2003). "Experimental study of the effects of heat treatment on microstructure and grain size of a gamma TiAl alloy." *Intermetallics*, Vol. 11, PP. 491-499.
- 7 - Bahmanpour, H., Heshmati-Manesh, S. and Ataie, A. (2006). "High Energy Ball Milling of Titanium and Aluminium Powder Mixture for Preparation of Activated Nanosized TiAl Intermetallic Alloys Precursor." *Proc., Int. Conf. on Manufacturing Science and Technology*, Melaka, Malaysia, PP. 231-234.
- 8 - Wang, Y., Wang, J. N., Xia, Q. and Yang, J. (2000). "Microstructure refinement of a TiAl alloy by heat treatment." *Material Science and Engineering A*, Vol. 293, PP. 102-106.
- 9 - Wang, J. N., Yang, J., Xia, Q. and Wang, Y. (2002). "On the grain size refinement of TiAl alloys by cyclic heat treatment." *Materials Science and Engineering A*, PP. 118-123.
- 10 - Jones, S. A. and Kaufman, M. J. (1993). "Phase equilibria and transformations in intermediate in Titanium Aluminium alloys." *Acta Metallurgica et materilia*, Vol. 41, No. 2, PP. 387-398.
- 11 - McCullough, C., Levi, C. G. and Mehrabian, R. (1988). "Microstructure evolution during conventional and rapid solidification of a Ti-50at%Al alloy." *Scripta Metallurgica*, Vol. 21, PP. 1341-1346.
- 12 - Ghasemiarmaki, H., Heshmati-Manesh, S. and Nili-Ahmadabadi, M. "Effect of homogenizing treatment on discontinuous coarsening  $\gamma$  and  $\alpha_2$  in Ti-47Al-2Cr intermetallic alloy." *Proc., 8<sup>th</sup> Conf. Metallurgical Engineering association*, Esfahan, Iran.
- 13 - Heshmati-Manesh, S., Nili Ahmadabadi, M., Ghasemiarmaki, H. and Jafarian, H. R. (2006). "Effect of initial microstructure and further thermomechanical processing on microstructural evolution in a Ti-47Al-2Cr alloy." *J. of Alloys and Compounds*, in press., Corrected Proof, Available online 8 August.
- 14 - Porter, D. A. and Easterling, K. E. (1983). *Phase Transformations in Metals and Alloys*, Van Nostrand Reinhold (UK) Co. Ltd.
- 15 - Heshmati-Manesh, S. (1992). *Phase Transformation and Thermomechanical Treatment of TiAl Based alloys containing Silicon.*, PhD Thesis, University of London, Imperial College, PP. 60-75.

### واژه‌های انگلیسی به ترتیب استفاده در متن

- |                           |                            |                              |
|---------------------------|----------------------------|------------------------------|
| 1 - Cyclic Heat Treatment | 2 - Massive Transformation | 3 - Stacking Fault           |
| 4 - Lamellar Structure    | 5 - Continuous Coarsening  | 6 - Discontinuous Coarsening |
| 7 - Feathery              |                            |                              |