



(- -)

/ /

:

(Cu+13wt%Al+3.8wt%Ni)

(Cu+13wt%Al+3.8wt%Ni)

,6hr °C850

(0.4,0.8)

()

,(3.5wt%NaCl)

STUDY THE EFFECT OF SILICON ADDITION ON THE CORROSION BEHAVIOR AND DRY SLIDING WEAR OF CU AL NI SHAPE MEMORY ALLOY

Dr. Abdul Raheem . K . Abid Ali
Babylon University

Zuheir T . Khulief.Al-Tai
Babylon University

Abstract:

In this search the effect of silicon additions on the corrosion and dry sliding wear behavior of (Cu+13wt%Al+3.8wt%Ni) shape memory alloy have been studies, alloys prepared by powder metallurgy in two case based alloy after sintering treatment at temperature 850 °C for 6hr and alloys after addition silicon as (0.4 , 0.8 wt%Si).Corrosion test based up electrochemical by drawing the polarization curves method (Tafel) in salt solution (3.5wt%NaCl).A Dry sliding wear has been studies based on pin on disk at a constant load, constant velocity and constant distance of sliding with various sliding time. The result shows when the silicon content increase the corrosion resistance of alloy increases also the dry sliding wear resistance of an alloy increases .

Key word :Corrosion ,Dry sliding wear ,Silicon ,Shape memory alloy.

:
 ,
 .(Adding ton,2005)
 (Ni + Ti) .(Miyazaki,1999)
 . (Otsuka etal ,2002) (Cu Al Ni, Cu Al Zr ,Cu Al Be)
 (Ni Ti)
 .(Samph etal ,2005) (Mn , Co ,Si , B , Ti , Zr)
 (Ni Ti)
 ,
 .(Souni etal,2002)
 (Ni Al) (Souni etal,2002)
 (Rondelli & Vicentini ,2002)
 (0.9% NaCl) (Ni Ti)
 (Ni Ti) .
 (Ni Ti) (Bogdansk etal,2004)
 (Li etal,2006) .
 (0.9% NaCl) (Ti₄₄ Ni₄₇ Nb₉)
 (Yan,2006) , (pH= 2.4 , 5.4 and 7.4)
 . (Ni Ti)
 . (Kaczmarek etal,2006) (Ni Ti)
 (Sun & Wang,2008)
 , (Ni Ti)

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(ZrO₂)
Ngk) (Ni Ti)
(Ni Ti) (etal,2008)
,(Vojtech etal,2010) (EDX) (SEM)

.(Voljtec etal,2011)(Ni Ti)

(Kuo etal,2006) , (Cu Al Zr) (Cu Al Ni)
, (H₂SO₄) (0.5M) (Cu Al Be) (Cu + Al)
(Abid Ali & Al-Tai,Z.,2010)
(5wt%) (Cu Al Ni)
(Cu-13wt% Al-3.8wt% Ni)
(0.4 and 0.8 wt% Si) (3.5 wt% NaCl)

(1) (, , ,)

.(6hrs.) (Ball Mills)
(850Mpa)
(14.5mm)
,(4-5mm) (14.5mm)
(=850) ,(20mm) (10mm)

(3hrs.)

Cu-)

Cu-13wt%Al-3.8wt%Ni-) (13wt%Al-3.8wt%Ni
 . (Cu-13wt%Al-3.8wt%Ni-0.8wt%Si) (0.4wt%Si
 :

:

(4-5mm) (14.5mm) : -1

(20mm) (10mm) : -2

:

(1200,1000,800,600,400,240,220) (SiC)
 ()
 ,(HERGON-mp200V)

:

(Cu-13wt%Al-3.8wt%Ni)

(0.4wt%;0.8wt%Si)

Mlab 200 Potentistat Banch Elektronik GMP,)

. (1) Germany ,2008 with SIC electrochemical sonfnat calculation)

(Reference) (Auxiliary Electrode)

(- -)

) (Saturated Calomelk)
(0.4,0.8 wt%Si)
(750ml) (3.5wt% NaCl)

(Mlab Sci-Electwchemica) (Potentionstat)
, (Bank -Elechtionies)
:
(Cu-13wt%Al-3.8%Ni)

(0.8wt%Si) (0.4wt%Si)
(AEGAM80FY6R3,2;25A;220Volt) , (2)
,(860rpm)

(173mm)
(273mm)
(55HRC) (23cm) , (6.4m/sec)
(14N)

,(±0.0001) (Sartorius)

:

$$\text{Weight Loss (g/cm}^2\text{)} = \Delta W/A$$

$$= \Delta W$$

$$= A$$

:

Cu-13wt%Al-

(Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

(3.8wt%Ni

)

(Cu-13wt%Al-3.8wt%Ni-0.8wt%Si)

(

(Union ME-3154)

(600X)

:

(3)

, (3.5wt%NaCl)

:

$$I_{\text{corr.}} = 55 \mu\text{A/cm}^2$$

$$E_{\text{corr.}} = -259.2 \text{mv}$$

(4)

, (3.5wt%NaCl)

(0.4wt%)

(Cu+13Alwt%+3.8Niwt%+0.4wt%Si)

:

$$I_{\text{corr.}} = 2.65 \mu\text{A/cm}^2$$

$$E_{\text{corr.}} = -216.8 \text{mv}$$

(- -)

(5)

, (3.5wt%NaCl)

(0.8wt%)

: (Cu-13Alwt%-3.8Niwt%-0.8wt%Si)

I corr.=1.62 μ A/cm²

E corr.= -307.1.2mv

(2)

(0.4wt%Si)

(0.8wt%Si)

I corr.=2.65 μ A/cm²

I corr.=1.62 μ A/cm²

Cu-13wtAl%-)

(6 a,b)

, (3.5wt%NaCl)

(3.8wt%Ni

Cu-13wt%Al-3.8wtNi-) (0.4wt%Si)

(7 a,b)

(8 a,b), (3.5wt%NaCl)

(0.4wt%Si

Cu-13wt%Al-3.8wtNi-) (0.8wt%Si)

.(3.5wt%NaCl)

(0.8wt%Si

(0.8wt%Si)

.(0.4wt%Si)

:

, (Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

(Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

,(9)

,(Abid Ali & Al-Tai,Z.,2010)

(0.4wt%)

(0.8wt%)

(, , , ,)

(, , ,)

(Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

(10 a,b)

(Cu-13wt%Al-3.8wt%Ni-0.8wt%Si)

(0.8wt%Si)

(0.4wt%Si)

:

-1

-2

0.8wt%

-3

:

Abid Ali ,A.K. and Al- Tai , Z.T.K., " The effect of Iron addition on the dry sliding wear and corrosion behavior of Cu Al Ni shape memory alloy ", Eng.&Tech.Journal,Vol.28,No.24,2010.

Adding ton , M and Schodek , D." Smart Materials and New Technologies For Architecture and Design Professions" , 2005, P.8.

Bogdanski , D.,Esen wein ,S.A.,Prymak , O., Epple , M.,Muhr,G. and Koller,M., " inhibition of PMN apoptosis after adherence to dip –coated Calcium phosphate surface on a Ni Ti shape memory alloy " , Biomaterials ,vol.25,2004,p.4627.

Kaczmarek ,M.,Simka ,W.,Baron,A.,Szewczenko,J.and Marciniak,J.," Electrochemical behavior of Ni-Ti alloy after surface modification " , J.Achievements in materials and manufacturing Engg.,vol.18,issue 1-2,2006.

Kuo, H.H, Wang,W.H., Hsu, Y.F. and Huang , C.A.," The corrosion behavior of Cu –Al and Cu – Al – Be shape memory alloys in 0.5 M H₂SO₄ solution " , corrosion science 48,2006,p.4352.

Li, C.,Zheng , Y.F. and Zhao , L.C.," Electrochemical corrosion behavior of Ti₄₄ Ni₄₇ Nb₉ alloy in simulated body fluids " , Mat. Science and engg, A 438-440,2006,P.504.

Miyazaki ,S.," Shape Memory Alloys " , Inst. Mater.Scie.1999.

Ng ,K.w,Man ,H.C. and Yue, T.M.," Corrosion and wear properties of laser 254,2008,p.6725.

Otsuka, K. and Kakeshita, T.," Science and Technology of Shape Memory Alloys : surface modified Ni Ti with Mo and ZrO₂" , Applied surface science , New developments" , MRS bulletin , Feb 2002.

Rondelli, G. and Vicentini ,B." Effect of copper on the localized corrosion resistance of Ni-Ti shape memory alloy" , Biomaterials,vol.23, 2002, P.639.

Sampath , V.," Effect of Zr addition on the micro structure and transformation temperatures of Cu Al Ni shape memory alloys " , Int.Conf .smart materials, structures and systems, Bangalore , In dia , July,2005,PP.28-30.

Souni , M.and Brandies,H.F.," On the properties of Two Binary Ni Ti shape memory alloys , effect of surface finish on the corrosion behavior and in vitro bio compatibility" , Biomaterials, Vol.23,2002,P.28-87.

Sun , T.and Wang ,M.," Low temperature biomimetic formation of apatite/ TiO₂ composite coatings on Ti and Ni Ti shape memory alloy and their characterization " , Applied surface science 255,2008, p.396.

Vojtech , D.,Voderova, M.,Fojt,J.,Novak, P. and Kubasek, T.," Surface structure and corrosion resistance of short time heat treated Ni Ti shape memory alloy" , Applied surface science 257,2010,P.1573.

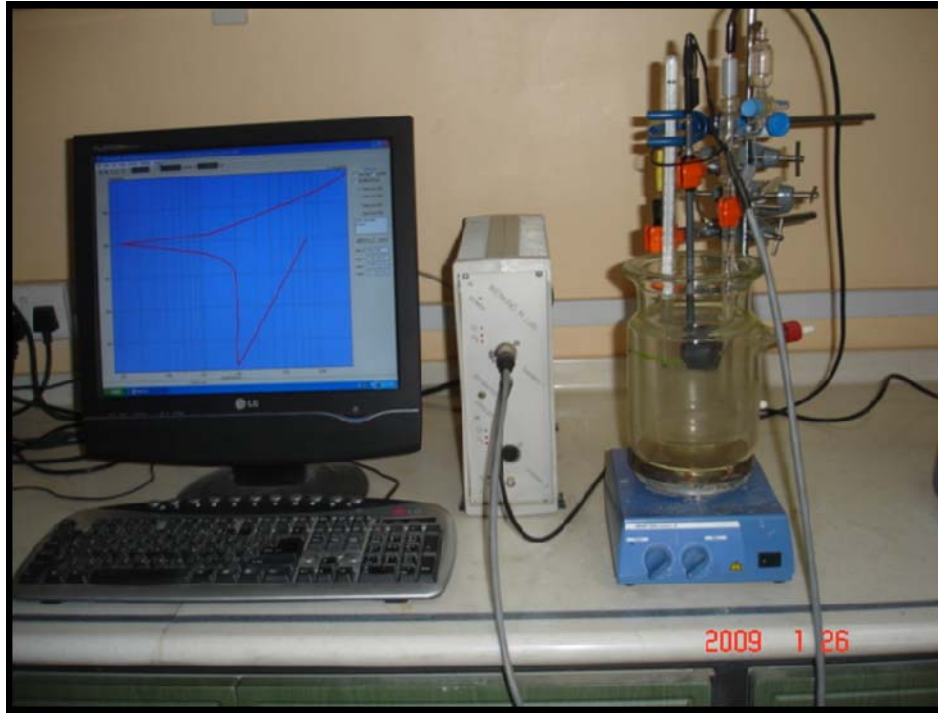
Vojtech, D.,Voderova ,M.,Kubasek, J.,Novak,P.,Seda,P.,Michal cova ,A,Fojt,J., Hanus,J. and Mestek,O.," Effect of short time heat treatment and subsequent chemical surface treatment on the mechanical properties , low – cycle fatigue behaviour and corrosion resistance of a Ni Ti biomedically alloy wire used for manufacture of stents " , Mat.Scie.Engg.A. 528,2011,P.1864.

Yan ,W." Theoretical investigation of wear – resistance mechanism of super elastic shape memory alloy Ni Ti" , Mat.Science and Engg,A 427,2006,P.348.

(1)

	%	(μm)	
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Cu	99.98	68	Merck Co.
Al	99.99	80	Merck Co.
Ni	99.90	38	Merck Co.
Si	99.90	63	Merck Co.

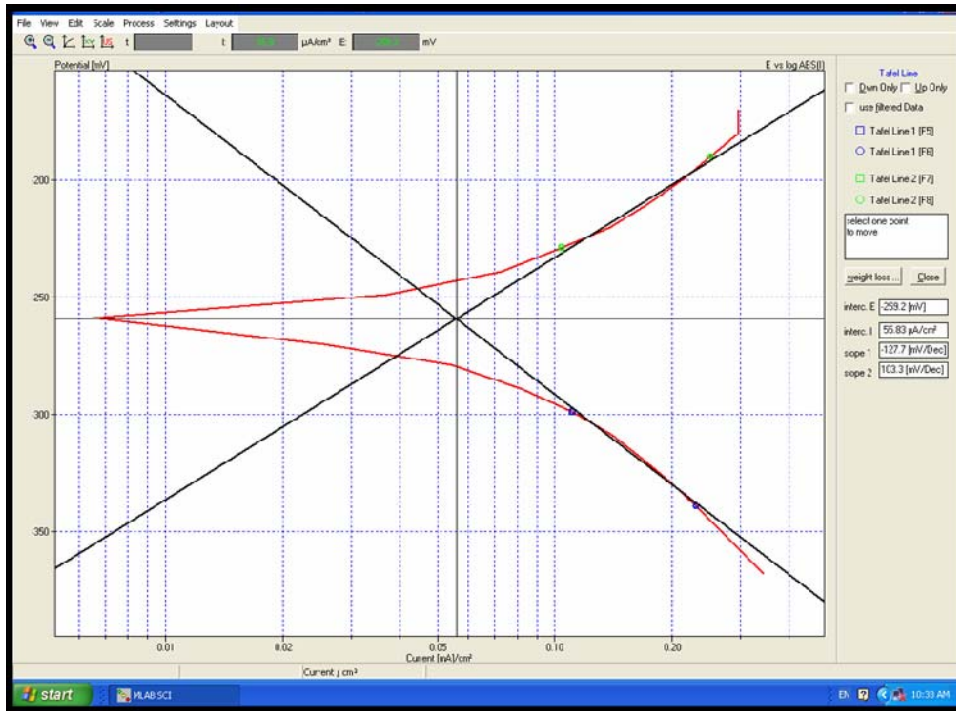


1



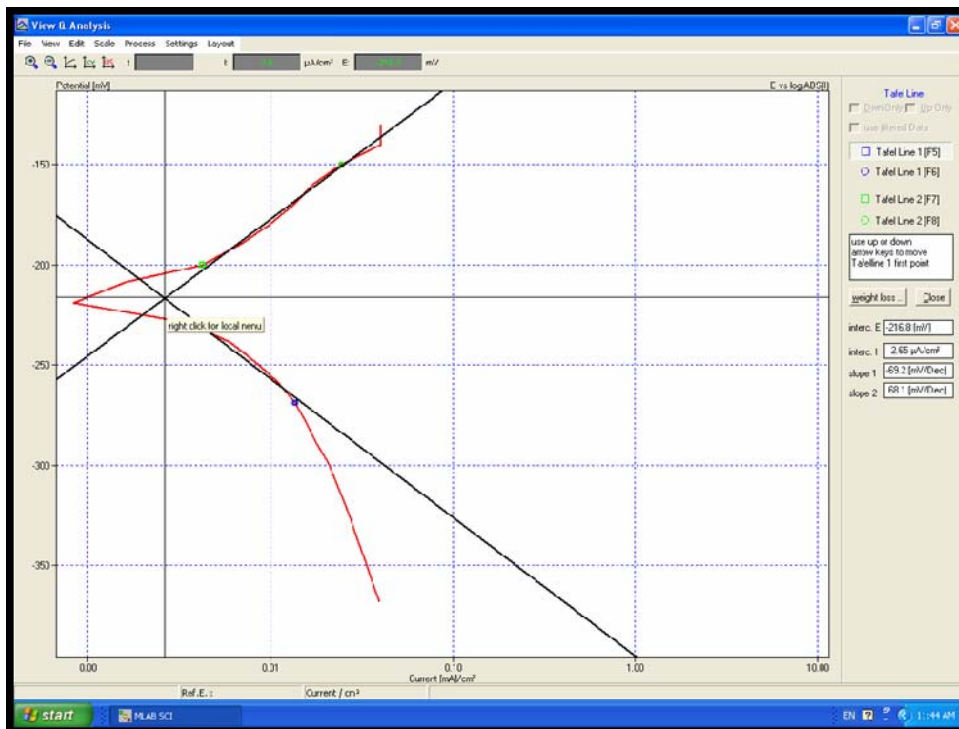
2

(- -)



(3.5wt%NaCl)

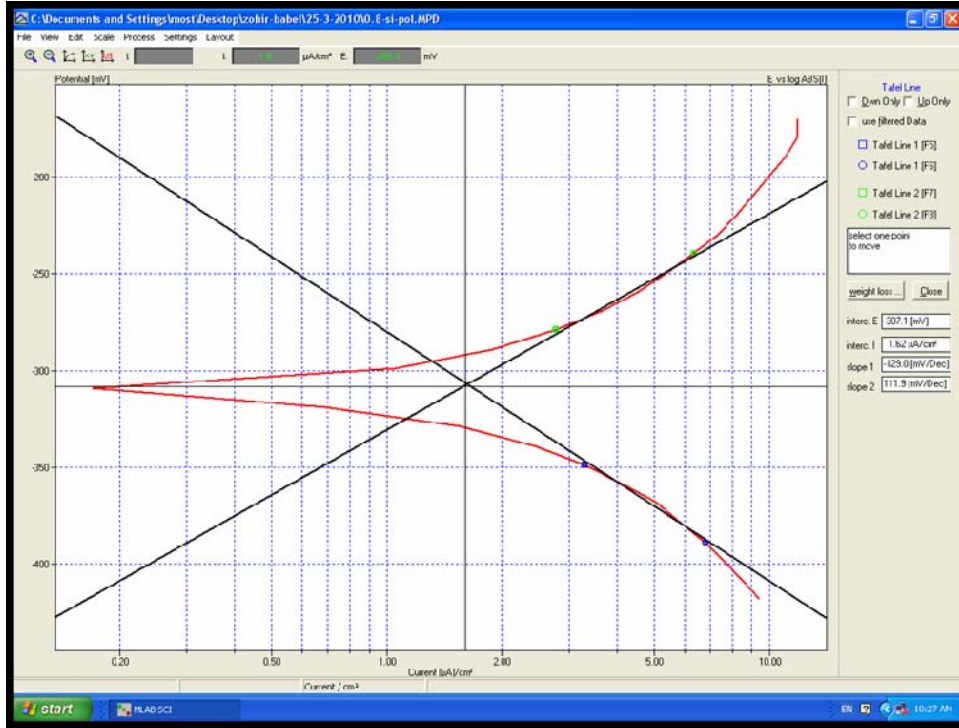
3



(Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

4

(3.5wt%NaCl)



(Cu-13wt%Al-3.8wt%Ni-0.8wt%Si)

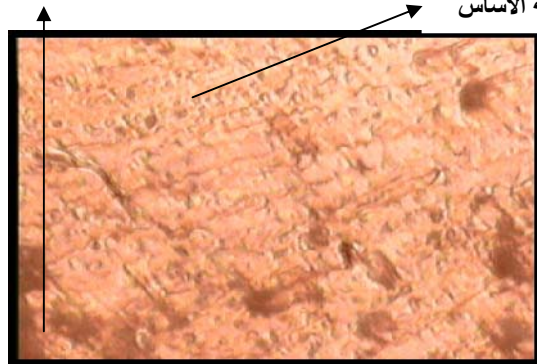
5

(3.5wt%NaCl)

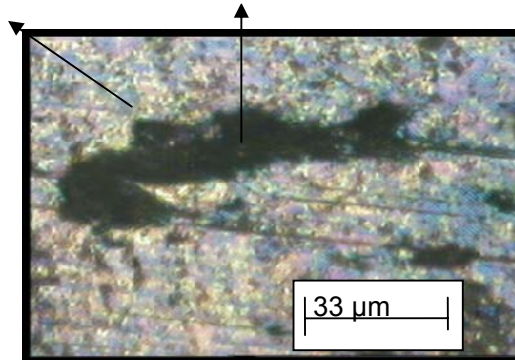
2

Alloy	I _{Coor.} (μA/cm ²)	E _{Corr.} (Mv)
After sintering	55	-259
After addition (0.4 wt% Si)	2.65	-216.8
After addition (0.8 wt% Si)	1.62	-307.2

مسامات

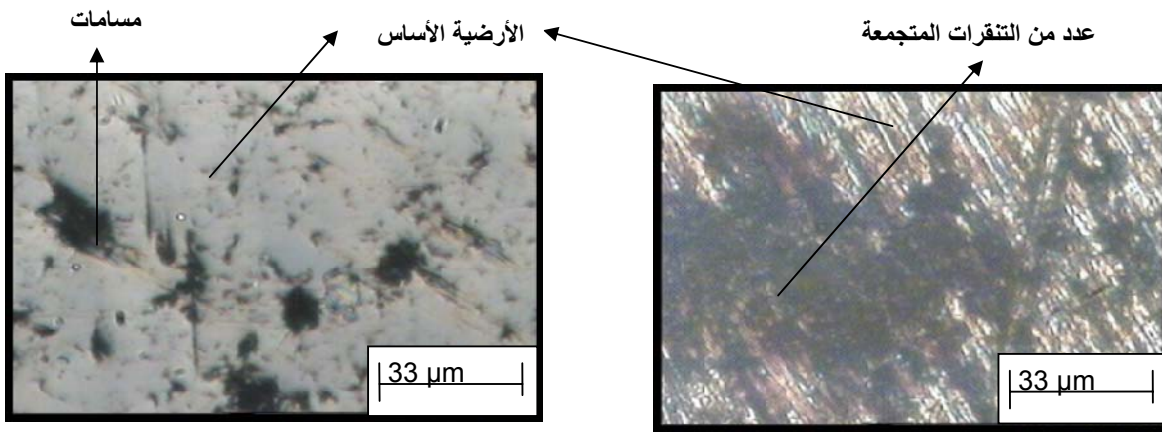


عدد من التفتقات المتجمعة



6a

6b



a

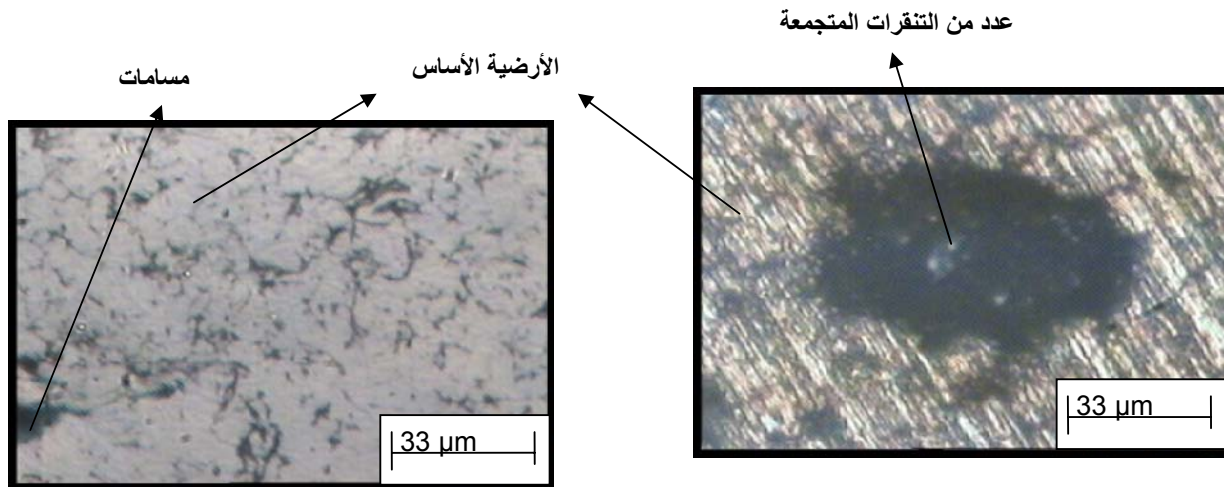
b

(Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

7a

(Cu-13wt%Al-3.8wt%Ni-0.4wt%Si)

7b



a

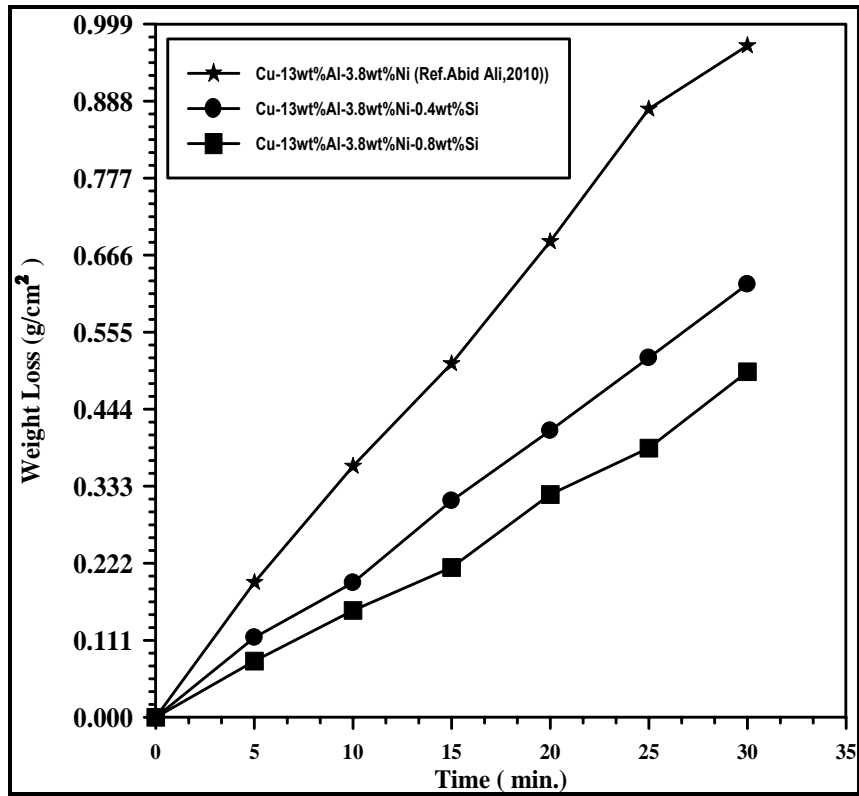
b

(Cu-13wt%Al-3.8wt%Ni-0.8wt%Si)

8a

(Cu+13wt%Al+3.8wt%Ni+0.8wt%Si)

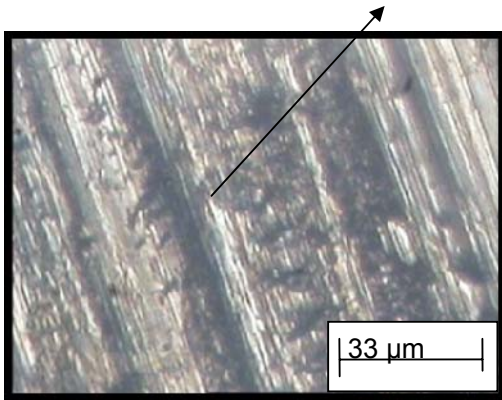
8b



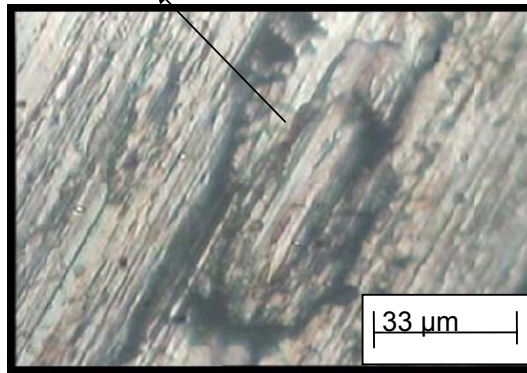
9

(,55HRC ,14N) .(

خطوط البلى الأتزان لاقى الجاف



a



b

(Cu-wt%Al-wt%Ni-0.4wt%Si)

10a

(Cu-wt%Al-wt%Ni-0.8wt%Si)

10b

,30min

,55HRC

,14N

)

(