

تأثير عناصر السبك (البورون ، التيتانيوم) والمعاملة الحرارية على خاصية الصلابة
الدقيقة لسبيكة (ألمنيوم – نحاس – مغنيسيوم)

(2xxx)
(Al-Cu-Mg)
150 °C, 175 °C,)
(%82.12)
(1.0% Ti) (0.1% B)
(0.1% B) (200 °C)
(Ti) (B)
(200 °C)
(1.0% Ti)
(200 °C)
(%65.91)

Abstract

Alloy (Al-Cu-Mg) is one of these importance alloys and it is one of (2xxx) series where Copper is the major alloying element act number (2) , several techniques were adopted to improve properties of the base alloy (Al – Cu – Mg) using alloying elements such as (B) and (Ti), was prepared four different types of alloys based and using heat treatments such as homogenizing treatment and artificial ageing achieved with various temperatures on the chemical composition (150°C,175°C,200°C) andwith different periods of time .

Results showed that the addition of (1.0% Ti) to base alloy improve Vickers hardness by (82.12%) at artificial ageing (200 °C) compared with base alloy. The addition of (0.1% B) and (1.0% Ti) to base alloy improve Vickers hardness by (65.91%) at artificial ageing (200 °C) . The addition of (0.1% B) to base alloy effect on the Vickers hardness of all cases of ageing , either the study of microstructure has been through the optical microscope for alloys after casting and after homogenization and after all the operations of artificial ageing was view microscopic structure change during the early stages mentioned and see the emergence of new phases in the structure of alloys , and has been compared all results of last tests with some of standard values.

Introduction :

(/)

(%)

() [Macchi *et. al.*, 2009]
/ (°C)
(DSC)

(Al-Cu-Mg) []
(Al_2O_3) (ZrO_2)
(1,3,4,5,6%)

() [Raza *et. al.*, 2011]

() (°C)
() °C

(4 hrs.) (210 °C)
(Cu/Mg) (Al-Cu-Mg) [Cooke *et. al.*, 2012]

(Al -2.3Cu - 1.6Mg)

(T6)

(20 hrs.) (200°C)

(Ti)

(B)

(Al-Cu-Mg) (- -)

Experimental Part : _____

Preparation of Alloys: _____ **1.2**

()

()

()

Alloy Code \ Composition	Al wt %	Cu wt %	Mg wt %	B wt %	Ti wt %
A	96	2	2	-	-
B	95.9	2	2	0.1	-
C	95	2	2	-	1.0
D	94.9	2	2	0.1	1.0

-:

(99.96%)

-1

(750°C)

-2

:

(99.99%)

(99.5%)

(5 - 4)

(15mm)

-3

(400 °C - 300)

Homogenizing Treatment : _____

(LINDBERG)

(500°C)

(1200°C)

()

()

Alloy Code	Condition
A, B, C, D	Homg. at 500°C for τ hrs. + Slow Cooling to R.T.

Homg. = Homogenization

R.T. = Room Temperature

Specimens Preparation :

(15mm) (7mm)

2000,1500,1200,1000,800,600,400,)

(HERGON)

(180

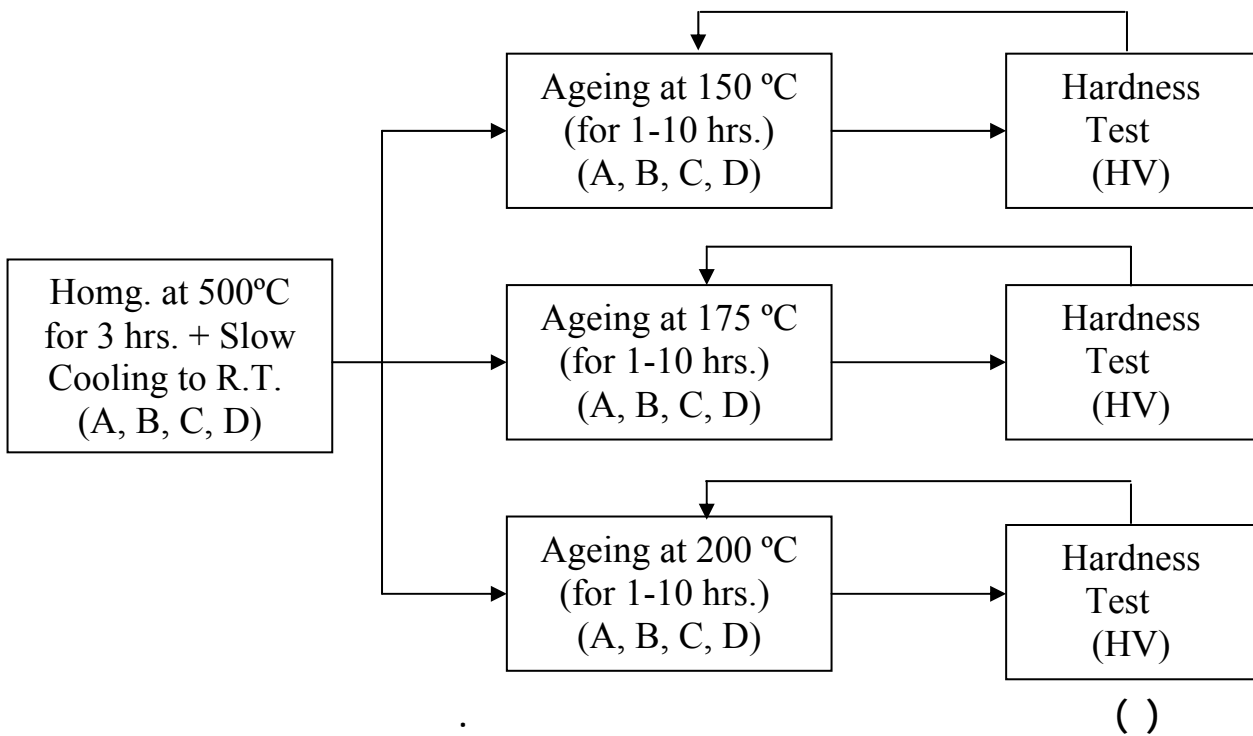
Artificial Ageing Treatment :

200 °C,

(A,B,C,D)

(175 °C, 150 °C)

()



()

Microhardness Test :

Vickers) ()
 (Microhardness
 . (10 s) (100g)

Microstructure Test : _____

(100X^o) (union ME-3154)

(HERGON)

: (Keller's Reagent)
 10 -20) (1cm³ HF, 1.5cm³ HCl, 2.5cm³ HNO₃, 95cm³ H₂O)
 .(s)

Results and Discussion : _____

. (200°C, 175°C, 150°C)

Microhardness of Alloys : _____

(As Cast)

(D) (B) (A) (C)

.() (Ti)

()

Alloy code	Condition	HV (Kg/mm ²)
A	As cast	,
B	As cast	,
C	As cast	,
D	As cast	,

(500°C)

(Ti) (C)

()

()

Alloy code	Condition	HV (Kg/mm ²)
A	Homogenizing	,
B	Homogenizing	,

C	Homogenizing	,
D	Homogenizing	,

((4))

_____ :

Effect of Artificial Ageing on Hardness

(A,B,C,D)

() () () (150°C)

(C) (200°C,175°C)

(B)

(Ti)

(C)

(α)

(800°C)

. [1989

]

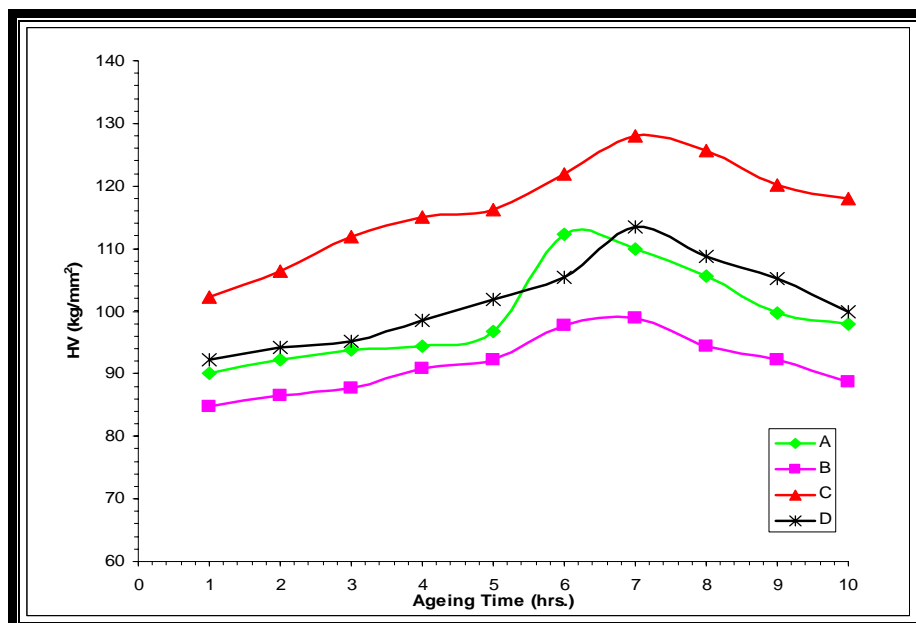
(β)

(Diffusion Process)

(Nucleation and Growth)

,Durbin Sigworth *et. al.*, 2006 Hutchinson *et. al.*, 2000]

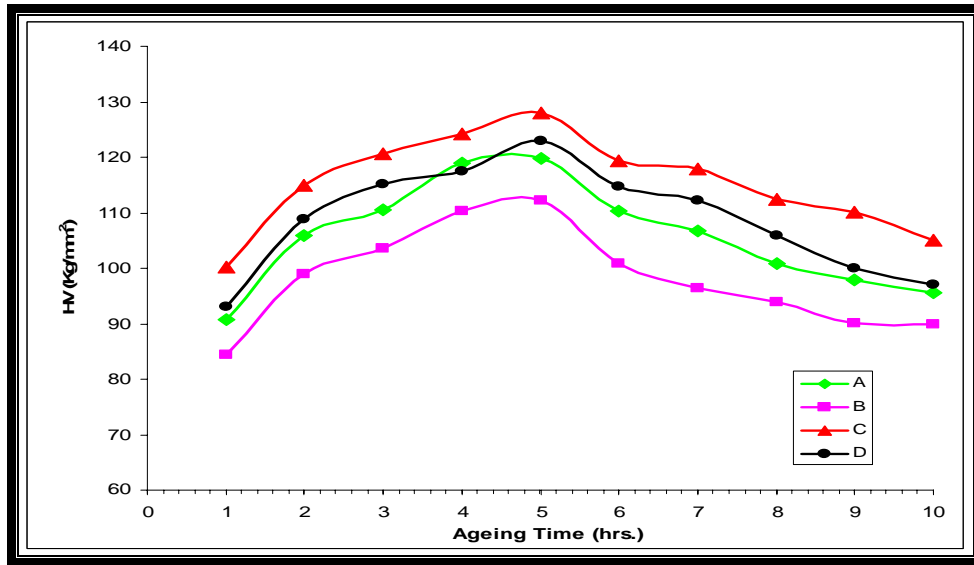
. [*et. al.*, 2005



(A,B,C,D)

()

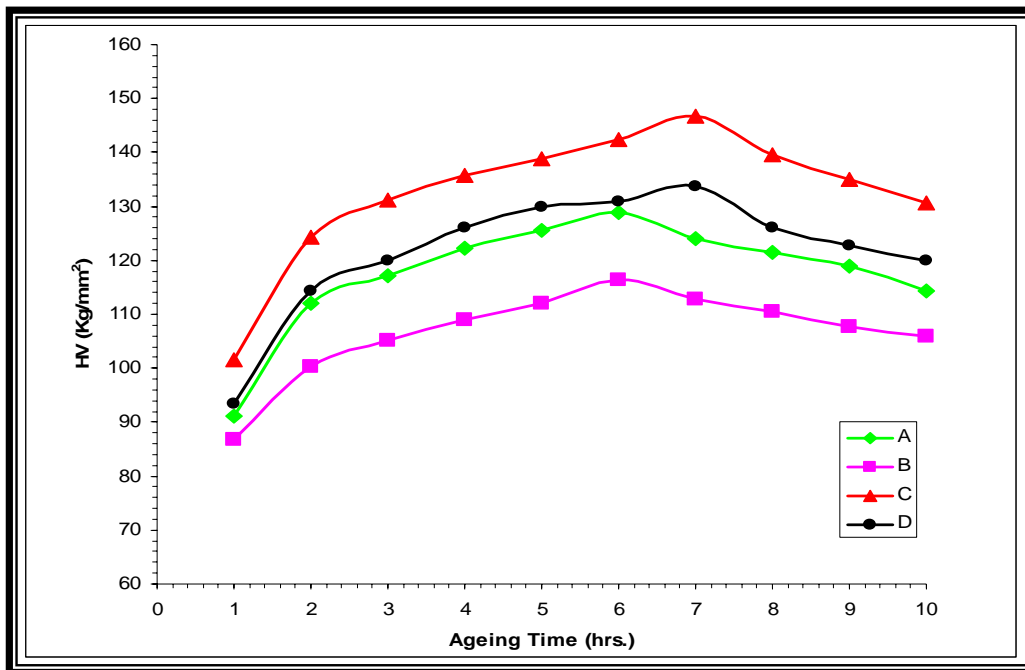
.(150°C)



(A,B,C,D)

()

.(175°C)



(A,B,C,D)

(4)

.(200°C)

	(Guinier – Preston Bagaryatsky) (GPB)	
(Ringer)	. (1960) (Silcok)	(S)
(1997)	(Atom Probe Field Ion Microscopy)	
	(1998) (Zahra)	. (GPB)
		(GPB)
S	(Ratchiv)	
	[Reich <i>et. al.</i> , 1999]	
	[Ringer <i>et. al.</i> , 2000 Reich <i>et. al.</i> , 1999]	
	:	
	(Quench in – Vacancies)	-1
		-2
(Preferred Interaction)		
		-3
		S
	(GPB)	-4
(S)	(GPB)	-5

Metallography Results :

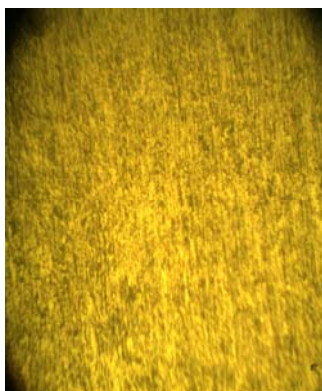
As Cast)

(

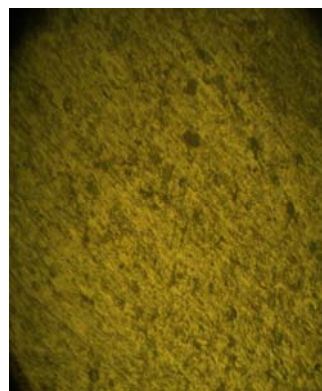
. (150°C,175°C,200°C)



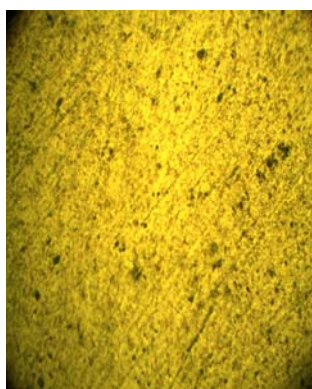
()
(D)



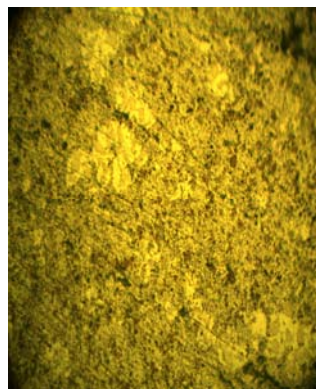
()
(B)



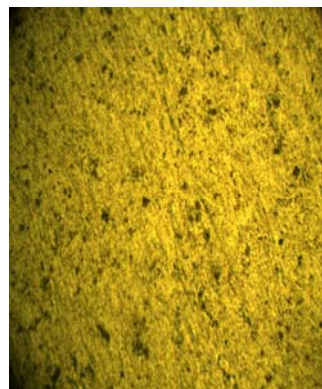
(5)
(A)



(10)
(D)
(200 °C)



(9)
(C)
(175 °C)



(8)
(A)
(150 °C)

(Resolution)

(Magnification)

Conclusions : _____

(Ti)

(Al-Cu-Mg-Ti) (C)

(Al-Cu-Mg)

(0.1%B)

7) (200 °C)
(175 °C , 150 °C) (hrs.

References :

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