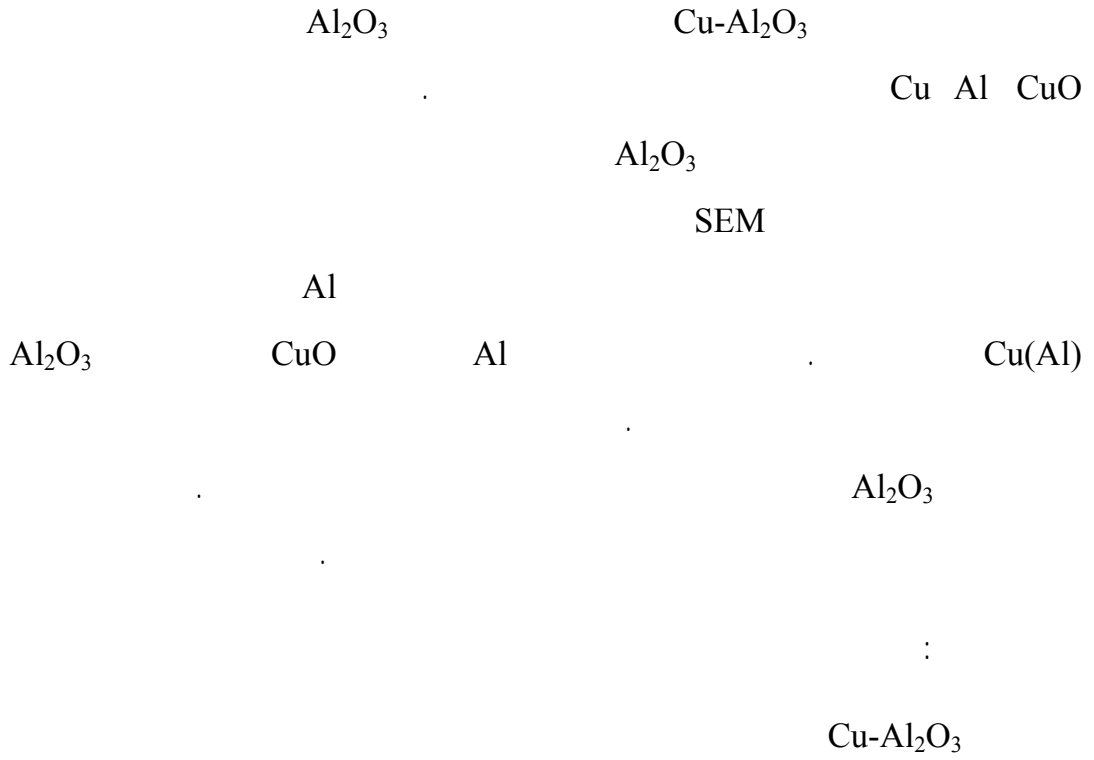
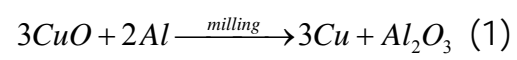
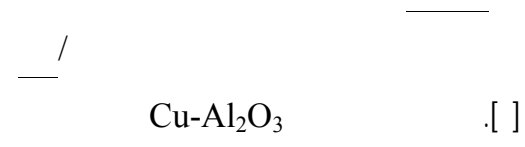
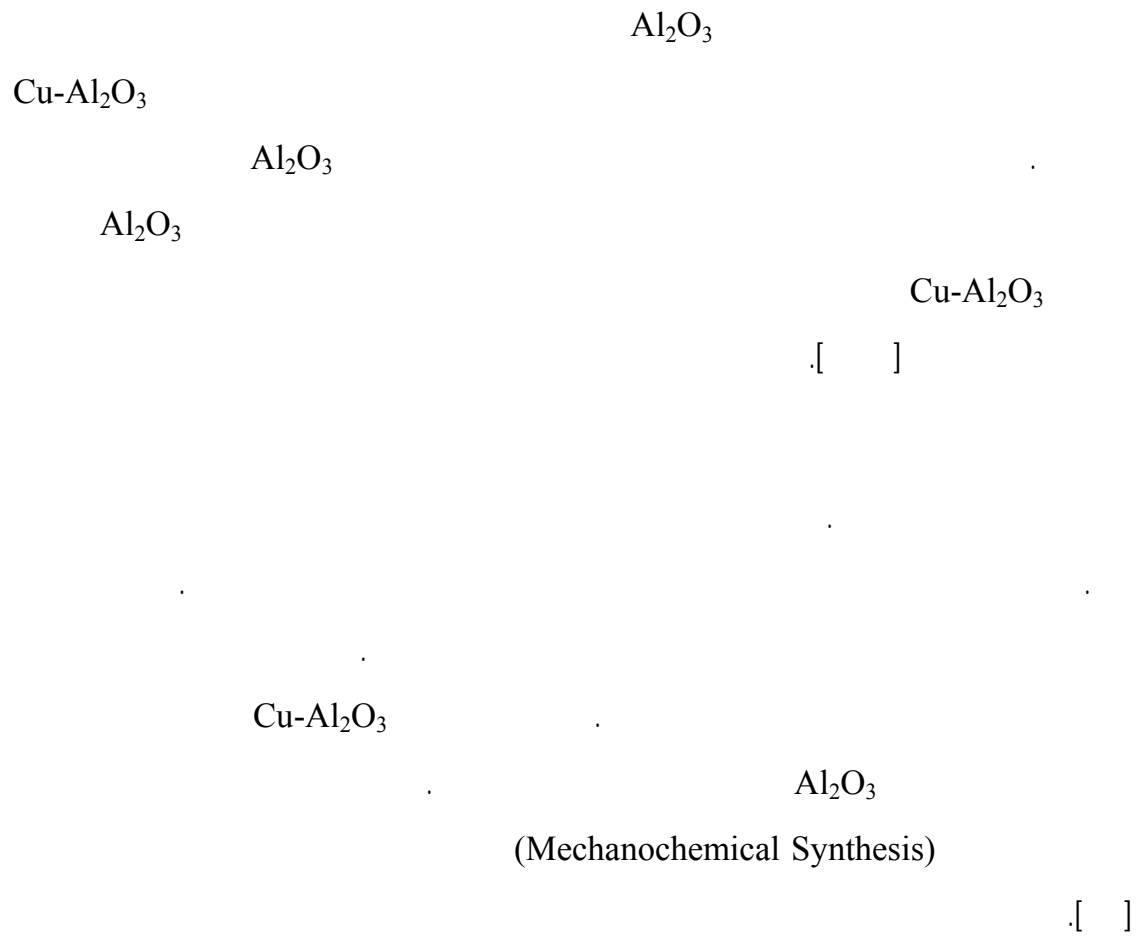


Cu-Al₂O₃





K

MSR

$$\frac{\Delta H_{298}}{C_{298}} > 2000K$$

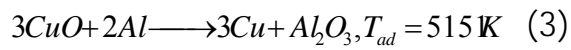
MSR

[]

:

Al

CuO



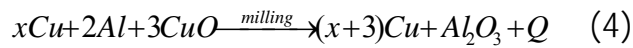
SPEX

CuO-Al

Al₂O₃

[]

Cu-Al₂O₃



Al CuO

MSR

MSR

$$\left(\begin{matrix} \text{Reactants, 298K} \\ xCu + 2Al + 3CuO \end{matrix} \right) \Rightarrow \left(\begin{matrix} \text{Products, 298K} \\ (x+3)Cu + Al_2O_3 + Q \end{matrix} \right) \Rightarrow \left(\begin{matrix} \text{Products, Tad} \\ (x+3)Cu + Al_2O_3 \end{matrix} \right)$$

:

⁵ ΔH_{298} انتالپی واکنش (۲) در دمای ۲۹۸ کلوین: ΔH_{298}

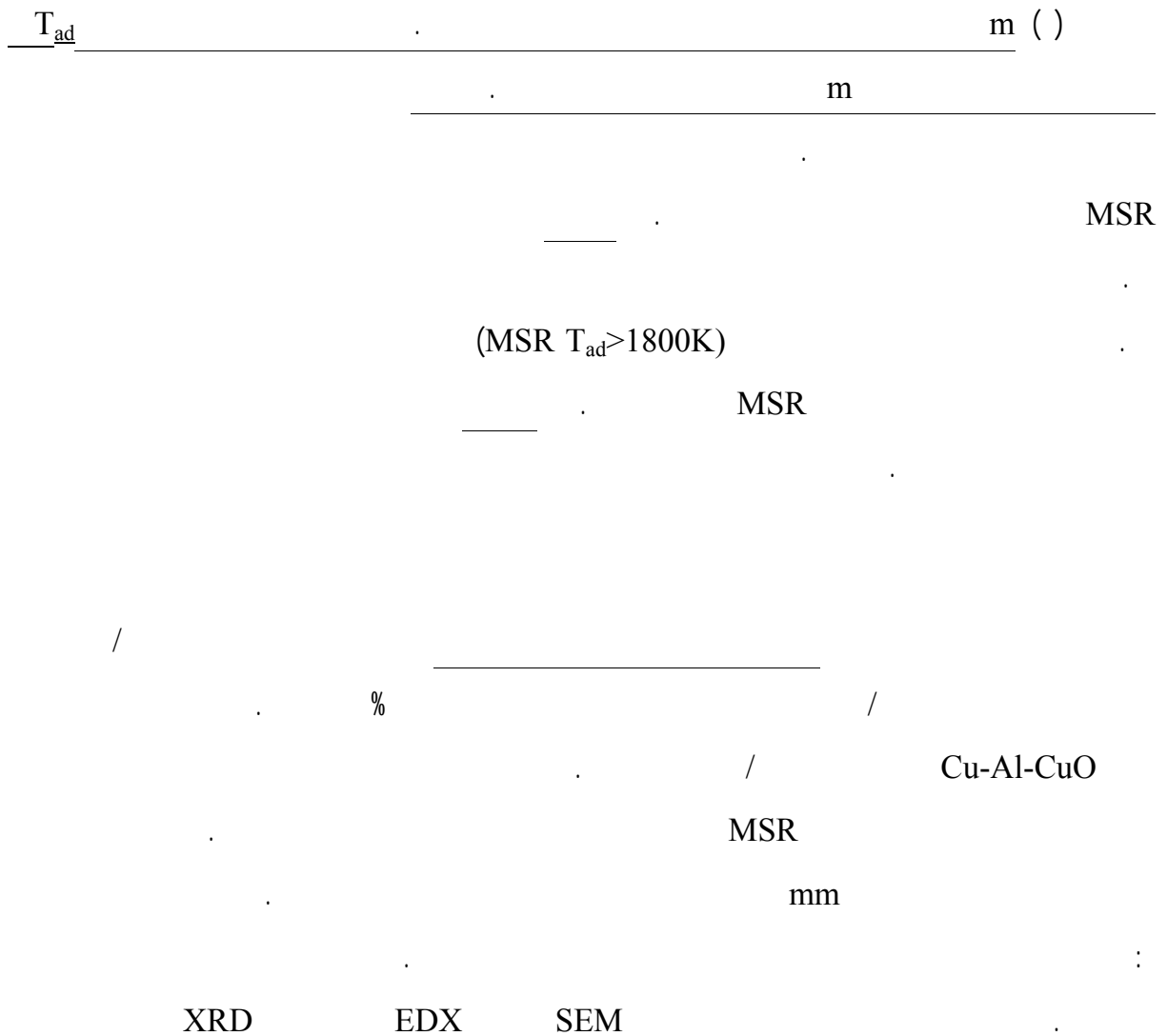
ظرفیت حرارتی اجزای واکنش (۲) در دمای ۲۹۸ کلوین: C_{298}

$$\Delta Q = \Delta H_{298}^{\circ}(\text{reaction}) + \int_{298}^{T_{ad}} C_p(\text{products}) .dT = 0 \quad (5)$$

:

$$\begin{aligned}
 -\Delta H_{298}^{\circ} = & \{(3+x)\left(\int_{298}^{1358} C_p^{Cu(sol)} .dT + \right. \\
 & \Delta H_f^{Cu} + \int_{1358}^{T_{ad}} C_p^{Cu(liq)} .dT + m(\Delta H_b^{Cu} + \\
 & \left. \int_{2868}^{T_{ad}} C_p^{Cu(gas)} .dT)\right) + \left(\int_{298}^{2325} C_p^{Al2O3(sol)} .dT + \right. \\
 & \left. \Delta H_f^{Al2O3} + \int_{2325}^{T_{ad}} C_p^{Al2O3(liq)} .dT\right)\}
 \end{aligned}$$

(6)



SEM

C₂ SEM Al /

(b)

(c,d,e) []

C₂

Al

Cu Al CuO

Al

Cu₂O CuO []

Cu{200} Cu{111}

Cu-Al

[]

Al

Cu

Al

[]

() () (a) d d

[]

$$d = \frac{\lambda}{2 \sin \theta} \quad ()$$

$$a = d \sqrt{h^2 + k^2 + l^2} \quad ()$$

2θ=43.32 Cu{111}

2θ=43.12

0.45%

3.630 3.614

Cu Al

2θ=43.33

Cu{111}

Cu Al

Cu

Cu₂O CuO Al

Cu(Al)

Al

- Al₂O₃

Cu Al

Al₂O₃

[]

Al₂O₃

C₁ C₃

C₃

MSR

($T_{ad} > 1800 \text{ K}$)

MSR

MSR

[]

T_{ig}

(C_1)

$$\frac{\Delta H}{C}$$

T_{ad}

Al CuO

MSR

Cu(111)

()

: () ()

$$d = \frac{0.9\lambda}{B \cdot \cos \theta} \quad ()$$

$$B \cdot \cos \theta = \frac{0.9\lambda}{d} + \eta \cdot \sin \theta \quad ()$$



$B \cdot \cos \theta$ []

$\sin \theta$

$$\frac{0.9\lambda}{d}$$

[]

()

C₂

/ /

Cu-Al₂O₃

Al CuO Cu

Cu-Al₂O₃

:

Al

Al CuO

Al₂O₃

MSR

Cu Al- CuO

MSR

Al₂O₃

1. M.S. Motta et al. , Materials Science and Engineering C 15(2001)175–177
2. P.K. Jena et al. , Materials Science and Engineering A313 (2001) 180–186
3. D.Y. Ying, D.L. Zhang : Materials Science and Engineering A286 (2000) 152–156
4. Handbook on the Physics and Chemistry of Rare Earths Vol. 24 edited by K.A. Gschneidner, Jr. and L. Eyring © 1997 Elsevier Science B. g All rights reserved
5. Zhang DL, Richmond JJ. J, Mater Sci 1999;34:701.
6. D.Y. Ying, D.L. Zhang , Materials Science and Engineering A361 (2003) 321–330
7. X. Shengqi et al. , Journal of Alloys and Compounds 268 (1998) 211 –214
8. S.J. Hwang, J. Lee , Materials Science and Engineering A 405 (2005) 140–146
9. L. Takacs , Progress in Materials Science 47 (2002) 355–414
10. J.B. Fogagnolo et al. , Materials Science and Engineering A342 (2003) 131–143
11. C. Suryanarayana , Progress in Materials Science 46 (2001) 1-184
12. X. J. Liu et al. , Journal of Alloys and Compounds 264 (1998) 201 –208
13. D. Das, P.P. Chatterjee, I. Manna and S.K. Pabi, Scripta Materialia, Vol. 41, No. 8, pp. 861–866
14. .Y. Ying, D.L. Zhang , Journal of Alloys and Compounds 311 (2000) 275 –282
15. B. D. Cullity, Element of X-Ray Diffraction, second edition, Department of Metallurgical Engineering and Materials Science University of Notre Dame

