

4. 結論

本論文乃研究熱處理對鐵-9 鋁-30 錳-1.0 碳合金機械性質影響，得到結論如下：

- (1). 合金在經過 1100°C 固溶熱處理之後可以得到完全的沃斯田鐵相顯微結構，合金擁有良好的強度和韌性。
- (2). 合金在經過 550°C、6 小時的時效熱處理後，因為有細小的 κ' -碳化物在沃斯田鐵晶粒內析出，造成了析出硬化的效果，且無析出物在晶界上析出，所以材料在沒有明顯損失韌性的情況下明顯的得到了最佳的強度。
- (3). 合金在經過 650°C、6 小時的時效熱處理後，因為不但在沃斯田鐵晶粒內有細小的 κ' -碳化物析出物，在晶界上也開始有一些粗大的 κ -碳化物異相析出，所以雖然材料因為析出硬化而在強度上達到最佳，但卻因為晶界上析出而造成材料韌性稍微下降。
- (4). 合金在經過 850°C、6 小時的時效熱處理後，在晶粒內的 κ' -碳化物變的很少，且在晶界上析出了大量粗大的 κ -碳化物，故材料的強度及韌性都大幅地下降。

- (5). 經過軋延過後的試片由於內部的樹枝狀結晶被破壞，故其內部的微結構及成份較鑄造試片更均勻，不會像鑄造試片內部有過多的溶質原子堆積在晶臂間，容易使粗大的 κ -碳化物在此間析出。故軋延試片在各個相同條件的時效熱處理均呈現更好的延展性。
- (6). 鑄造試片經過各不同時效熱處理後，破斷模式是比較偏向脆性的穿晶、沿晶破斷。而軋延試片在經過各不同時效熱處理後，破斷行為以延性的酒窩狀凹洞為主，隨著時效溫度上升，輔以稍具脆性的穿晶破斷。



5. 參考文獻

1. G.S. Krivonogov, M.F. Alekseyenko and G.G. Solov'yeva, Phys. Met. Metallogr., **39(4)**, 86(1975).
2. W.K. Choo and K.H. Han, Metall. Trans. A, **16A**, 5(1985).
3. W.K. Choo and K.H. Han, Metall. Trans. A, **20A**, 205(1989).
4. K. Sato, K. Tagawa and Y. Inoue, Metall. Trans. A, **21A**, 5(1990).
5. N.A. Storchak and A.G. Drachinskya, Phys. Met. Metallogr., **44**, 123(1977).
6. T.F. Liu and C.M. Wan, Strength Met. Alloys, **1**, 423(1986).
7. K.H. Han, J.C. Yoon and W.K. Choo, Scripta Metall. **20**, 33(1986).
8. W.K. Choo and K.H. Han, Metall. Trans. A, **14A**, 973(1983).
9. W.K. Choo, K.H. Han and D.E. Laughlin, Scripta Metall., **22**, 1873(1988).

10. K. Sato, K. Tagawa and Y. Inoue, Scripta Metall., **22(6)**, 899(1988).
11. G.L. Kayak : Met. Sci. Heat Treat., **11(2)**, 95(1969).
12. J.E. Krzanowski, Metall., Trans. A, **19A**, 1873(1988).
13. M.F. Alekseyenko, G.S. Krivonogov, L.G. Kozyreva, I.M. Kachanova and L.V. Arapova, Metal Sci. Heat Treat., **14**, 187(1972).
14. P.J. James, J. Iron Steel Inst. **54**. Jan. (1969).
15. L.I. Lysak, M.F. Alekseyenko, A.G. Drachinskaya, N.A. Storchak and G.S. Krivonogov, Metallogizika, **59(4)**, 29(1975).
16. T.F. Liu, "Hot-Rolled Alloy Steel Plate", U.S. patent No. 4968357(July 1990).
17. K. Sato, K. Tagawa and Y. Inoue, Mater. Sci. Eng., **A111**, 45(1989).
18. S.C. Tjong, Mater. Char., **24**, 275(1990).
19. T.F. Liu, J.S. Chou and C.C. Wu, Metall. Trans. A, **21A**, 1891(1990).
20. C.Y. Chao and T.F. Liu, Scripta Metall., **25**, 1623(1991).

21. Z. Sun, H.A. Davies and J.A. Whiteman, *Metal Sci.*, **18**, 459(1984).
22. A. Inoue, Y. Kojima, T. Minemura and T. Masumoto, *Metall. Trans. A*, **12A**, 1245(1981).
23. 鐵鋁錳不鏽鋼高溫機械性質的研究，國科會研究結案報告
24. 碳矽元素對鐵錳鋁合金高溫機械性質之影響，國科會研究結案報告
25. C.C.Wu, J.S.Chou and T.F.Liu, *Metallurgical Transactions A*, V22A (1991) P2265-2276, "Phase transformation in an Fe-10.1Al-28.6Mn-0.46C alloy"
26. J.H.Han, *Acta Metall.*, V39 (1991) P2169-2173, "The role of deformation twin on mechanical properties of an Austenite Fe-30Mn-1.2Al-0.3C alloy"
27. 彭尚文博士論文，鉬對鐵鋁錳碳合金相變化及銲接性質的影響。
28. Y.G.Kim, *Material Sci. And Engi.*, V114 (1989) P51-59, "Composition and temperature dependence of tensile properties of Austenite Fe-Mn-Al alloys"

29. 連雙喜，Proc. Of the 1989 Annual Conf. of the NSC for FEMNAL Alloy，P68，”高氮鐵鋁錳合金的研究”
30. 陳立輝，Proc. Of the 1989 Annual Conf. of the NSC for FEMNAL Alloy，P49，” 沃斯田鐵系鐵錳鋁合金的動態應變時效
31. 劉發信、袁文明、湯鑫、楊愛德、陳婉華，”高溫合金細晶鑄造技術的發展與應用”，材料工程，1990年，7-11頁
32. 周介誠、張煥修、陳寬裕，”精密鑄造 IN-713LC 超合金製程-組織機械性質關係之研究”鑄工，59期，1998年1-12頁
33. 賴耿陽編著，”鑄造技術用書-10.特殊鑄造技術”復漢出版社，207-264頁
34. 傅豪，陳武宏編著，”精密鑄造技術”，文京圖書公司，421-422頁
35. 賴耿陽，”非鐵金屬材料”，1990年
36. M.Karlik etc.，Material Science and Engineering，A289（2000）P182-188，”Tensile deformation and fracture micromorphology of an Fe-28Al-4Cr-0.1Ce alloy”

37. K.S.Kim S.H.Huh and K.Suganuma , Microelectronics Reliability , 43(2003)P259-267 , ”Effect of fourth alloying additive on microstructure and tensile properties of Sn-Ag-Cu alloy and joints with Cu
38. M.Geni and M.Kikuchi , Computational Material Science , 16(1999)P391-403 , ”Void configuration under constrained deformation in ductile matrix material”
39. D.J.Lin, J.H.Chen and C.P.Ju , Material chemistry and physics , 76 (2002) P191-197 , ”Effect of omega phase on deformation behavior of Ti-7.5Mo-xFe alloy”
40. G. Bertolino, G. Meyer and J.perez Ipina , Journal of nuclear material , 320 (2003) P272-279 , ”Effects of hydrogen content and temperature on fracture toughness of Zircaloy-4”
41. N.Chawla etc. , Material science and engineering A 308 (2001) P180-188 , ”Axial fatigue behavior of binder-treated versus diffusion alloyed powder metallurgy steels”
42. W.S.Dai L.H.Chen and T.S.Lui , Wear , 239 (2000)

- P143-152 , "A study on SiO₂ particle erosion of flake graphite and spheroidal graphite cast iron"
43. Ola Wall , Engineering Fracture Mechanics , 69 (2002)
P835-849 , "Dynamic crack propagation in large steel specimens"
44. Samsul Rizal and Hiroomi Homma , International journal of impact engineering , 24(2000)P69-83 , "Dimple fracture under short pulse loading"
45. Lixin Pang and K.S.Kumar , Intermetallics , 8 (2000)
P157-163 , "On the impact toughness of Fe-40Al-based B₂ aluminides"
46. R.G. Baligidad etc , Materials science and engineering ,
A269 (1999) P235-128 , "Effect of aluminum content on creep and stress rupture properties of high carbon Fe-Al alloys"
47. C.C.Menzemer etc , Material science and engineering ,
A289(2000)P198-207 , "The impact toughness and tensile properties of 8320 steel"
48. D.J.Alexander etc , Materials science and engineering A ,

- 258 (1988) P276-284 , ”Processing and alloying effects on tensile and impact properties of FeAl alloys”
49. D.Dumont etc , Materials science and engineering A , 356
(2003) P326-336 , ”On the relationship between microstructure, strength and toughness in AA7050 aluminum alloy”
50. Dingqiang Li etc , Materials science and engineering A , 249
(1998) P206-216 , ”Effect of temperature on the tensile properties and dislocation structures of FeAl alloys”
51. Mingwei Chen etc , Materials science and engineering A ,
239-240 (1997) P317-323 , ”Strain rate sensitivity of ductility and fracture behaviors in a Fe-28Al alloy”
52. A.Deschamps etc , Materials science and engineering A ,
319-321 (2001) P583-586”High temperature cleavage fracture in 5383aluminum alloy”
53. K.C.Hwang etc. , Materials science and engineering A , 254
(1998) P296-304 , ”Effects of alloying elements on microstructure and fracture properties of cast high speed steel rolls Part II. fracture behavior”

54. R. Wouters and L.Froyen , Materials Characterization , 36
(1996) P357-364 , "Scanning electron microscope
fractography in failure analysis of steels"
55. Lihe Qian etc. , Materials science and engineering A , 318
(2001) P189-196 , "Dynamic fracture toughness of
6061Al composites reinforced with SiC particulates"
56. Tarun Goswami , Materials Design , 23 (2002)
P385-390 , "Conjoint bending torsion fatigue-
fractography"
57. Y.H.Tan, S-L Lee, and H-Y Wu , Int.J.Fatigue , Vol.18, No.2
(1996) P137-147 , "Effects of beryllium on fatigue crack
propagation of A357 alloys containing iron"
58. T.Mukai etc. , Acta Materialia , 51 (2003)
P4197-4208 , "Nanostructured Al-Fe alloys produced by
e-beam deposition static and dynamic tensile properties"
59. H.T. Lee etc. , Materials science and engineering A , 358
(2003) P134-141 , "Influence of interfacial intermetallic
compound on fracture behavior of solder joints"
60. M.Erdogan and S.Tekeli , Material and Design , 23 (2002)

P597-604 , ”The effect of martensite particle size on tensile fracture of surface-carburized AISI 8620 steel with dual phase core microstructure”

61. S.Rizal etc. , Engineering fracture mechanics , 69 (2002) P1377-1390 , ”Experimental approach to dimple fracture mechanisms under short pulse loading”
62. J.Bystrzycki and R.A.Varin , Materials science and engineering A , 270 (1999) P151-161 , ”Environmental sensitivity and mechanical behavior of boron-doped Fe-45at%Al intermetallic in the temperature range from 77 to 1000°K”
63. C-H.Tsau , Materials chemistry and physics , 75 (2002) P296-300 , ”The effects of interfaces on the mechanical properties of Ni-Al-Fe intermetallics”
64. M.L.Saucedo-Muñoz , Cryogenics , 40 (2000) P693-700 , ”Effect of microstructure evolution on fracture toughness in isothermally aged austenitic stainless steels for cryogenic applications”
65. 楊勝裕碩士論文, 鐵-8.8 鋁 30.0 錳-6.0 鉬-1.1 碳合金相

變化

66. D.J. Schmatz : Trans. ASM. 52, 898(1960).
67. J.C. Garcia, N. Rosas and R.J. Rioja : Met. Prog., Aug.,
47(1982).
68. J. Charles, A. Berghezan, A. Lutts and P.L. Dancoisne : Met.
Prog., May, 71(1981)

