THE EFFECT OF AGING PRECIPITATES TO MECHANICAL PROPERTIES ON AZ91D MAGNESIUM ALLOY

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ABSTRACT

IN THE NEW CENTURY,THE LIGHTWEIGHT MATERIALS WILL BE ON THE DOMINATED POSITION.THEREFORE, THE INVESTIGATIONS RELATING TO MAGNESIUM AND ALUMINUM ALLOYS WERE NEVER INTERRUPTED.NOT ON -LY THE 3C ELECTRONIC INDUSTRIES MAKE USE OF LIGHTWEIGHT MATERIALS,BUT ALSO WIDELY APPLIED IN VEHICLE AND AEROSPACE INDUSTRIES TO REDUCE THE WEIGHT OF BODY. THESE EFFORTS WILL REACH THE GOALS OF INCREASING FUEL EFFICIENCY,DECREASING FUEL CONSUMPTION AND CONTROLLING EXHAUS -T GASES EMISSION.IN RECENT YEARS,THE FULLY ALUMINUM VEHICLES WERE DEVELOPED AND FABRICATE D.DUE TO THE PROGRESS OF THE TECHNETRONIC GENERATION AND PEOPLE SEEK THE SUPERIOR QUALITY OF PRODUCTS (LIGHTWEIGHT、MULTI-FUNCTION, ETC.), WHICH HELPS TO MATERIALIZE THE MAGNESIUM ALLOYS TO BE THE DOMINATED MATERIAL IN THE NEW GENERATION. AS WE KNOWN, THE MAGNESIUM ALLO -YS EXIST MANY EXCELLENT CHARACTERISTICS (EX. LOW SPECIFIC DENSITY、HIGH SPECIFIC STRENGTH AND RIGIDITY、LARGE THERMAL CONDUCTIVITY、HIGH DAMPING CAPACITY、BETTER CORROSION RESISTAN -CE AND GOOD ELECTROMAGNETIC INTERFERENCE, ETC.). NEVERTHELESS, THE HCP CRYSTAL STRUCTURE INHIBITS THE LOW TEMPERATURE FORMABILITY AND THE TECHNIQUES OF HEAT TREATMENT、WELDING AND FORGING ARE NOT WELL DEVELOPED YET. FOR ABOVE REASONS, THE APPLICATIONS OF MAGNESIUM ALLO -Y WERE TEMPORARILY CONSTRAINED.AS WE KNOWN, THE AZ91D MAGNESIUM ALLOY IS THE MOST POPULAR MATERIAL TO FABRICATE THE MAGNESIUM PRODUCTS.THEREFORE, IN THIS RESEARCH PROGRAM,EXTRUDED AZ91D MAGNESIUM ALLOY PLATE WITH 6 MM THICKNESS WAS SELECTED TO DO THE HEAT-TREATED EXPER IMENTS. FROM A SERIES OF TEMPERATURE VS. AGING TIME COMBINATIONS, TRY TO CORRELATE THE REL ATIONSHIP AMONG GRAIN SIZE、MICRO-HARDNESS、MECHANICAL STRENGTH、ELONGATION AND TOUGHNESS. ALSO, ANALYZE THE CHEMICAL COMPOSITION、ELEMENTS COMBINATION AND MORPHOLOGY WITH VARIOUS TYPES OF PRECIPITATES WHICH FORMED DURING DIFFERENT HEAT-TREATED PROCESSES. ANALYZING THE OBTAINED DATA, WE CAN FIGURE OUT THE CORRELATION BETWEEN PRECIPITATION MECHANISMS AND MECHANICAL PROPERTIES. AFTER THAT, WE CAN EASILY DETERMINE THE PARAMETER TO CONTROL THE PRECIPITATE FORMATION AND TO PROMOTE THE MATERIAL PROPERTIES (EX. STRENGTH、TOUGHNESS, ETC.). ACCORDING TO THE PRELIMINARY TENSILE TESTS SHOWN THAT THE SPECIMEN WITH 15~20MM GRAIN SIZ -E EXIST BEST TOUGHNESS AND ELONGATION RESULTS. THEREFORE, THE PARAMETER WITH MAXIMUM TENS -ILE STRENGTH AND ADEQUATE GRAIN SIZE CAN BE OBTAINED AND APPLIED IT TO THE DUAL AGEING TR -EATMENT.HOPEFULLY, AFTER THE DUAL AGEING TREATMENT,THE OPTIMIZED MECHANICAL PROPERTIES CA -N BE ACHIEVED AND ENLARGED THE APPLICATION FIELDS OF MAGNESIUM ALLOYS.

Keywords : LIGHTWEIGHT MATERIAL、AZ91D MAGNESIUM ALLOY HEAT-TREATED PROCESSES、PRECIPITATION PHASES 、DUAL AGEING TREATMENT

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REFERENCES

1. "輕量化應用領域之新興潛力型材料",姜志華,金屬工業32卷1期, PP.57~60,1998. 2."鎂合金板材之壓型加工技術",王建義,工業材料雜誌170期,PP.132~136. 3."鎂合金材料特性及新製程發展",楊智超,工業材料 152期,PP.72~80,1999. 4."鎂合金在電子產品上的應用與產業概況",蔡幸甫,工業材料 152期,PP.62~71,1999. 5. "AZ61 鎂合金的疲勞性質與破壞分析", 劉文勝,中央大學機械所碩士論文, 2000. 6. M.REGEV,E.AGHION,A.ROSEN,AND M. BAMBERGER,"CREEP STUDIES OF COARSE-GRAINED AZ91D MAGNE -SIUM CASTINGS", MATERIALS SCIENCE AND ENGINEERING A252,PP.6~16,1998. 7. A. MUNITZ, C. COTLER, A. STERN, AND G. KOHN, "MECHANICAL PROPERTIES MICROSTRUCTURE OF GAS TUNGSTEN ARC WELDED MAGNESIUM AZ91D PLATES", MATERIALS SCIENCE AND ENGINEERING A30 2, PP.68~73, 2001. 8. A.K. DAHLE, Y.C. LEE, M.D. NAVE, P.L. SCHAFFER, AND D.H. ST. JOHN, "DEVELOPMENT OF THE AS-CAST MICROSTRUCTURE IN MAGNESIUM-ALUMINUM ALLOYS", JOURNAL OF LIGHT METALS,PP.61~72 ,2001. 9."機械材料",高立書局,吳炳南等人編著,1993. 10."輕金屬產業的發展趨勢",蔡幸甫,工業材材166 期, PP.165~168 ,2000. 11."鎂合金材料特性及新製程發展",楊智超,工業材料 152 期, PP.72~80,1999. 12. H. FRIEDRICH AND S. SCHUMANN, "RESEARCH FOR A "NEW AGE OF MAGNESIUM IN THE AUTOMOTIVE INDUSTRY", JOURNAL OF MATERIAL PROCESSING TECHNOLOGY 117,PP.276~281,2001. 13."輕金屬產業之未來",蔡幸甫,2000. 14."鎂合金之現況與發展前景", HTTP://MEMBER.PSCNET.COM.TW/ MANDOC/RESEARCH/REP-3/3-20000726 143551.HTM ,蔡純芬, 2000. 15."鋁鎂合金於汽機車產業之應用發展趨勢", 大葉大學演講資料,金屬工業研究發展中心,王俊傑,1999 16."筆記型電腦的新趨勢-鎂合金", HTTP://SEARCH.ETOP.COM.TW/RESEARCH/4MONTHSTOCK/FINANCIAL4- 2.HTML,許維哲, 2000. 17. YUAN GUANGYIN, SUN YANGSHAN, AND DING WENJIANG, "EFFECTS OF BISMUTH AND ANTIMONY ADDIT -IONS ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF AZ91 MAGNESIUM ALLOY", MATERI -ALS SCIENCE AND ENGINEERING A308, PP.38~44,2001. 18."鎂合金時效行為之研究",魏振仁,義守大學材料所碩士論文,2001. 19. RAJASHEKHAR SHABADI, RAJAN AMBAT, E.S. DWARAKADASA, K.L. BHAT, AND V. GOPALAKRISHNAN, "STUDIES ON CADMIUM AND SILVER TRACE ELEMENT MODIFIED AZ91C MAGNESIUM ALLOY",MAGNESIUM ALLOYS AND THEIR APPLICATIONS INT. CONF., GERMANY, PP.65-72, 2000. 20. GUANGLING SONG, ANDREJ ATRENS, AND MATTHEW DARGUSCH, " INFLUENCE OF MICROSTRUCTURE ON THE CORROSION OF DIE-CAST AZ91D", CORROSION SCIENCE 30, PP.249-273, 1999. 21. YIZHEN LU, QUDONG WANG, XIAOQIN ZENG, WENJIANG DING, CHUNQUAN ZHAI, AND YANPING ZHU, "EFFECTS OF RARE EARTHS ON THE MICROSTRUCTURE, PROPERTIES AND FRACTURE BEHAVIOR OF MG- AL ALLOYS", MATERIALS SCIENCE AND ENGINEERING, A278,PP. 66-76, 2000. 22. J.F. NIE, X.L. XIAO, C.P. LUO, AND B.C. MUDDLE,"CHARACTERIZATION OF PRECIPITATE PHASES IN MAGNESIUM ALLOYS USING ELECTRON MICRODIFFRACTION", MICRON 32,PP.857-863, 2001. 23. S. CELOTTO, "TEM STUDY OF CONTINUOUS PRECIPITATION IN MG-9 WT.% AL-1 WT.% ZN ALLOY",AC -TA MATER. 48, PP.1775~1787, 2000. 24. S. CELOTTO, AND T.J. BASTOW,"STUDY OF PRECIPITATION IN AGED BINARY MG-AL AND TERNARY M G-AL-ZN ALLOYS USING 27AL NMR SPECTROSCOPY", ACTA MATER. 49, PP.41-51, 2001. 25. M. REGEV, O. BOTSTEIN, M. BAMBERGER, AND A. ROSEN, " CONTINUOUS VERSUS INTERRUPTED CRE -EP IN AZ91D MAGNESIUM ALLOY", MATERIALS SCIENCE AND ENGINEERING A302, PP.51~55, 2001. 26. I.J. PLOMEAR, "LIGHT ALLOY: METALLURGY OF THE LIGHT METALS", ARNOLD, 1995. 27. R.A. HIGGINS, "ENGINEERING METALLURGY", EDWARD ARNOLD,1983. 28. ZHAN ZHANG, AND ALAIN COUTURE, "AN INVESTIGATION OF THE PROPERTIES OF MG-ZN-AL ALLOYS" ,SCRIPTA MATERIALIA, VOL.39, PP.45-53, 1998. 29. LYMAN, TAYLOR. BOYER, AND HOWARD E., "METALS HANDBOOK VOL.8 METALLOGRAPHY, STRUCTURES, AND PHASE DIAGRAMS", METALS PARK, OHIO AMERICAN SOCIETY FOR METALS, PP.305~311, 1974. 30. ANON., ASTM E384-84, "STANDARD TEST METHOD FOR MICRO HARDNESS OF MATERIALS",

CHAPMAN AND HALL, NEW YORK, 1991. 31. "工程材料學", 全華書局, 楊榮顯, 1997. 32. CHARLIE R., "PRECIPITATION HARDENING IN MAGNESIUM-BASE BINARY ALLOY", HEAT TREATMENT, STRUCTURE AND PROPERTIES OF NONFERROUS ALLOYS, PP.255-274, 1982. 33. OLIVIER BEFFORT AND CHRISTIAN HAUSMANN, EMPA-THUN, "DAS LEICHTMETALL MAGNESIUM DAS LEI CHTMETALL MAGNESIUM UND SEINE UND SEINE LEGIERUNGEN", MAGNESIUM-SEMINAR(EMPA), 1999. 34. A. ELIEZER,E.M. GUTMAN, E. ABRAMOV, AND YA. UNIGOVSKI "CORROSION FATIGUE OF DIE-CAST AND EXTRUDED MAGNESIUM ALLOYS", JOURNAL OF LIGHT METALS 1, PP.179-186, 2001. 35."機械材料", 文京書局, 黃振賢, 1998. 36."X光繞射原理與材料結構分析", 國科會精儀中心, 許樹恩、吳泰伯, 1993. 37. B.W. CHUA, L. LU, AND M.O. LAI, "INFLUENCE OF SIC PARTICLES ON MECHANICAL PROPERTIES OF MG BASED COMPOSITE", COMPOSITE STRUCTURES, VOL.47, PP.595~601, 1999. 38. Y.LI,AND H.JONES, "EFFECT RARE EARTH AND SILICON ADDITIONS ON STRUCTURE AND PROPERTIES OF MELT SPUN MG-9AL-1ZN ALLOY", MATERIALS SCI. AND TEC., VOL.12, PP.651-659, 1996.