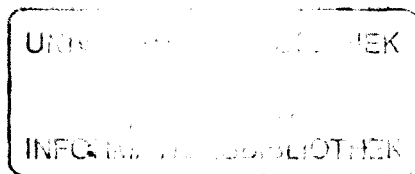


Magnesium Alloys and their Applications

Edited by **K. U. Kainer**



Deutsche Gesellschaft
für Materialkunde e.V.



Weinheim · New York · Chichester
Brisbane · Singapore · Toronto

Contents

Alloy Development

Global Overview on Demand and Applications for Magnesium Alloys <i>R. L. Edgar, Hydro Magnesium, Brussels (B)</i>	3
Focused Development of Magnesium-Alloys Using Computational Thermochemistry as a Powerful Tool <i>R. Schmid-Fetzer, J. Gröbner, Institute of Metallurgy, Technical University of Clausthal (D); D. Kevorkov, Institute of Metallurgy, Technical University of Clausthal (D)</i>	9
Development of Practical High Temperature Magnesium Casting Alloys <i>J. F. King, Magnesium Elektron, Manchester (GB)</i>	14
Development of a Low-cost, Temperature- and Creep-resistant Magnesium Die-casting Alloy <i>F. von Buch, S. Schumann, Volkswagen AG Wolfsburg (D); E. Aghion, B. Bronfin, Dead Sea Magnesium, Beer-Sheva (IL); B. L. Mordike, Department of Materials Engineering and Technology, Technical University Clausthal (D); M. Bamberger, Technion, Haifa (IL); D. Eliezer, Ben-Gurion University of the Negev, Beer-Sheva (IL)</i>	23
Creep Resistant Mg Alloy Development <i>K. Pettersen, H. Westengen, Norsk Hydro Research Centre, Porsgrunn (N); J. I. Skar, M. Videm, Norsk Hydro Research Centre, Porsgrunn (N); L.-Y. Wei, Luleå University of Technology (S)</i>	29
Development of High Temperature Creep Resistant Alloys <i>B. L. Mordike, Institute of Material Science and Engineering, Technical University Clausthal (D); F. von Buch, now: VW Forschung Wolfsburg (D)</i>	35
New Magnesium Wrought Alloys <i>C. Jaschik, H. Haferkamp, M. Niemeyer, Institut of Materials Science, University of Hanover (D)</i>	41
Effects of Alloying Elements of the Creep Resistance of Thixomolded Mg-Al-Ca-X (X=Si, Zn, Mn, Ba, Sr) Alloys <i>T. Tsukeda, R. Uchida, K. Saito, The Japan Steel Works, Ltd. (J); M. Suzuki, J. Koike, K. Maruyama, H. Kubo, Tohoku University, Tohoku (J)</i>	47
Precipitation Processes in Magnesium-Heavy Rare Earth Alloys during Ageing at 300°C. <i>P.J. Aapps, G. W. Lorimer, Manchester Materials Science Centre, Manchester (GB); H. Karimzadeh, J.F. King, Magnesium Elektron, Manchester (GB)</i>	53

Grain Refinement of Magnesium Casting Alloys by Boron Addition

N. Nishino, H. Kawahara, Y. Shimizu, H. Iwahori, Toyota Central R & D Labs., Inc., Aichi (J).....59

Studies on Cadmium and Silver Trace Element Modified AZ91C Magnesium Alloy
R. Shabadi, E. S. Dwarakadasa, UGC Center for Advanced Studies, Indian Institute of Science, Bangalore (IND);

R. Ambat, University of Birmingham (GB);

K. L. Bhat, Department of Metallurgical and Materials Engineering, KREC, Surathkal. (IND);

V. Gopalakrishnan, Foundry and Forge Division, Hindusthan Aeronautics Limited, Bangalore (IND)65

Electrophysical Properties of Mg-Pb Based Liquid Alloys and Their Application.

Y. Plevachuk, Institute of Applied Physics, Ivan Franko National University, Lviv (UA)73

Mg-Al-(Sc, Gd) Alloy Design Using Computational Thermochemistry

J. Gröbner, D. Kevorkov, R. Schmid-Fetzer, Institute of Metallurgy, Technical University of Clausthal (D);

A. Pisch, Laboratoire de Thermodynamique et Physico-Chimie Métallurgiques Institut National Polytechnique de Grenoble, Saint Martin d'Hères (F).....79

Mg-alloy Database Construction: Investigation of Al-Li-Si Phase Equilibria

D. Kevorkov, J. Gröbner, R. Schmid-Fetzer, Institute of Metallurgy, Technical University of Clausthal (D)84

Mg- alloy Database Construction: Investigation of Al-Ca Phase Equilibria

D. Kevorkov, R. Schmid-Fetzer, Institute of Metallurgy, Technical University of Clausthal (D)88

Aging Response of Mg-Rare Earth Alloys with Low Scandium Content

B. Bohumil Smola, Institute of Materials Engineering, Czech Technical University, Prague (CZ);

I. Ivana Stulíková, J. Jitka Pelcová, Faculty of Mathematics and Physics, Charles University, Prague (CZ);

F. Frank von Buch, B. L. Barry L. Mordike, Institute of Material Science and Engineering, Technical University Clausthal (D).....92

Phase Equilibria, Microstructure and Properties of Novel Mg-Mn- Y Alloys

A. Pisch, C. Antion, C. Tassin, F. Baillet, Laboratoire de Thermodynamique et Physico-Chimie Métallurgiques Institut National Polytechnique de Grenoble, Saint Martin d'Hères (F);

J. Joachim Gröbner, R. Schmid-Fetzer, Institute of Metallurgy, Technical University of Clausthal (D)98

Microstructure and Protium Absorbing/desorbing Characteristics of Mg-Ni-Mn Alloys

H. Hayato Okumura, T. Tohru Tabata, A. Akihiro Matsui, S. Shigeharu Kamado, Y Kojima, Department of Mechanical Engineering, Nagaoka University of Technology, Nagaoka (J) 103

Heat and Corrosion Resistance of Mg-Zn-Al-Ca Alloys

- I. A. Anyanwu, T. Honda, Nagaoka University of Technology, Nagaoka (J);
S. Kamado, Y. Kojima, Department of Mechanical Engineering, Nagaoka University of
Technology, Nagaoka (J);
S. Takeda, T. Ishida, Magnesium Manufacturing Division, Ahresty Corporation,
Tokyo (J)* 110

Texture and Microstructure

Texture Analysis as a Tool for Wrought Magnesium Alloy Development

- S. R. Agnew, M. H. Yoo, J. A. Horton, Oak Ridge National Laboratory,
Oak Ridge, TN (USA)*..... 119

Microstructure, Texture and Residual Microstrains in MgAl₈Zn Deformed at Very High Strain Rates

- A. Pyzalla, Hahn-Meitner-Institut, Berlin (D);
M. Brodmann, Lehr- und Forschungsgebiet Werkstoffkunde, RWTH Aachen (D);
P. L. Lee, D. Haeffner, Advanced Photon Source, Argonne National Lab.,
Argonne, IL (USA)* 125

Zn Incorporation within the Intermetallic Mg₁₂(La_xCe_{1-x}) Lattice in Elektron MEZ

- C. J. Bettles, C. J. Rossouw, K. Venkatesan, CSIRO Manufacturing Science and
Technology, Victoria (D)* 131

Orientation Relationship in Mg-Mg₁₇Al₁₂ Eutectic

- S. Guldberg, Hydro Magnesium, Porsgrunn (N);
N. Ryum, Department of Materials Technology and Electrochemistry, NTNU,
Trondheim (N)*..... 137

Influence of Texture on Deformation Behaviour of Magnesium Alloy AZ31

- R. Gehrman, M. M. Frommert, G. Gottstein, Institut für Metallkunde und Metallphysik,
RWTH Aachen (D)* 143

Ageing Behaviour and Microstructure of a Mg-9Al-3Zn Alloy.

- K. Venkatesan, C. J. Bettles, CSIRO Manufacturing Science and Technology,
Victoria (D)*..... 149

Magnesium SiC Reinforced Composites - Texture and Residual Strain Investigation by Simulation and Experiments

- H.-G. Brokmeier, E. M Jansen, IWWTU Clausthal and GKSS-Forschungszentrum
Geesthacht (D);
P. Spalthoff, J. A. Signorelli, P. A. Turner, Instituto de Física Rosario (RA);
R. E. Bolmaro, IGD-UNIV. Göttingen (D) and FLNP-JINR Dubna-Russia (RUS)* 155

Effect of Thermomechanical Treatments on the Microstructure of AZ91 Alloy

- N. V. Ravi Kumar, J. J. Blandin, M. Suéry, Institut National Polytechnique de Grenoble
(INPG), Génie Physique et Mécanique des Matériaux (GPM2), Saint-Martin d'Hères (F)*..161

Magnesium Applications in Aerospace and Electronic Industries <i>B. Landkof, Technion, Israel Institute of Technology</i>	168
Joining	
Friction Stir Welding of Lightweight Materials <i>S. W. Kallee, W. M. Thomas, E. D. Nicholas, TWI Ltd, Cambridge (GB)</i>	175
Strategies to Reduce Porosity in Electron Beam Welds of Magnesium Die-Casting Alloys <i>C. Vogelei, D. von Dobeneck, pro-beam KGaA, Planegg/München (D); I. Decker, H. Wohlfahrt, Institut für Schweißtechnik, Technische Universität Braunschweig (D)</i>	191
Influences on the Static and Dynamic Strength of MIG-welded Magnesium Alloys <i>M. Rethmeier, S. Wiesner, H. Wohlfahrt, Institut für Schweißtechnik, Technische Universität Braunschweig (D)</i>	200
Magnesium Matrix Composites	
Design Rules for Selective Reinforcement of Mg-Castings by MMC Inserts <i>H. P. Degischer, Institute of Materials Science and Testing, Vienna University of Technology, Vienna (A); F. G. Rammerstorfer, Institute of Lightweight Structures and Aerospace Engineering, Vienna University of Technology, Vienna (A); O. Beffort, Swiss Federal Laboratories for Material Testing and Research, Thun (CH)</i>	207
The Influence of Ca-Additions on the Mechanical Properties of T300-C-Fibre/Mg(Al) Metal Matrix Composites <i>O. Beffort, Swiss Federal Laboratories for Material Testing and Research, Thun (CH); C. Hausmann, VonRoll Druckguss AG, St.Gallen (CH)</i>	215
Fabrication and Properties of Cast and Extruded SiCw/AZ91Mg Composites <i>J. Kaneko, M. Sugamata, J. Kim, M. Masataka Kon, Nihon University Izumi-cho, Narashino, Chiba (J)</i>	221
Thermal Fatigue of Magnesium Matrix Composites <i>F. Chmelík, P. Lukác, Department of Metal Physics, Charles University, Praha (CZ); S. Kúdela, Institute of Materials and Mechanical Engineering, Slovak Academy of Sciences, Bratislava (SK); J. Kiehn, B. L. Mordike, Department of Materials Engineering and Technology, Technical University Clausthal (D); K.-U. Kainer, Institute for Materials Research, GKSS Investigation Centre, Geesthacht (D)</i>	229
Microstructure and Creep Behavior of SiC Particulate Reinforced QE 22 Composite <i>M. Svoboda, M. Pahutova, J. Brežina, V. Sklenicka, Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Brno (CZ); F. Moll, Institute of Materials Engineering and Technology, Technical University of Clausthal (D)</i>	234

Formation of Mg ₂ Si by Infiltration of C-Fibres-Si-Hybrid-Preforms <i>K. U. Kainer, H. Dieringa, Inst. für Werkstoffforschung GKSS-Forschungszentrum Geesthacht (D); P. Schulz, J. Reiter, Leichtmetall Kompetenzzentrum Ranshofen (A)</i>	240
Flow Mechanisms in Creep of an AZ 91 Magnesium-based Composite <i>V. Sklenicka, M. Pahutova, K. Kucharova, M. Svoboda, Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Brno (CZ); T. G. Langdon, Departments of Materials Science and Mechanical Engineering, University of Southern California, Los Angeles, CA (USA)</i>	246
Possibilities of the Heat Treatment of Magnesium Matrix Composites Reinforced with SiC Particles <i>K. N. Braszczynska, Technical University of Czestochowa (PL)</i>	252
Fabrication and Microstructure Analysis of Al ₁₈ B ₄ O ₃₃ Ceramics Reinforced Magnesium Alloy Matrix Composites <i>G. Sasaki, S. Hara, M. Yoshida, J. Pan, H. Fukinaga, Dept of Mech. Eng., Hiroshima University, Higashi-Hiroshima (J); N. Fuyama, T. Fujii, Western Hiroshima Pref. Industrial Res. Inst., Kure (J)</i>	257
Dynamic Behaviour of Magnesium Matrix Composites in Elevated Temperature <i>E. Lach, T. U. Benzler, K. U. Kainer, GKSS Research Centre – Geesthacht (D); A. Bohmann, M. Scharf, ISL, French-German Research Institute of Saint-Louis (F)</i>	263
Mechanical Development	
The Use of Magnesium in Cars – Aspects of Corrosion <i>M. Brettmann, B. Reinhold, H. Schnattinger, Audi AG, Ingolstadt (D)</i>	271
Mechanical Properties of Extruded Magnesium Alloys <i>B. Closset, Timminco SA, Geneva (CH)</i>	274
The Grain Size Dependence of Strength in the Extruded AZ91 Mg Alloy <i>M. Mabuchi, Y. Yamada, K. Shimojima, C. E. Wen, Y. Chino, M. Nakamura, T Asahina, Materials Processing Department, National Industrial Research Institute of Nagoya (J); H. Iwasaki, Himeji Institute of Technology, Shosha, Himeji, Hyogo (J); T. Aizawa, Department of Metallurgy, The University of Tokyo, (J); K. Higashi, Department of Metallurgy and Materials Science, Osaka Prefecture University, Gakuen-cho, Sakai, Osaka (J)</i>	280
Formability and Strain Rate Sensitivity of a Mg-8.5Li-1Zn Alloy Sheet <i>H. Takuda, Kyoto University, Kyoto (J); S. Kikuchi, The University of Shiga Prefecture, Hikone (J); K. Kubota, Mitsui Mining & Smelting Co. Ltd., Ageo (J)</i>	285
Mechanical Properties of Magnesium Alloys Processed by Semi-Solid Casting <i>W. Wager, D. Hartmann, EFU Gesellschaft für Ur-/Umformtechnik mbH, Simmerath (D); F. Lehnert, BMW Group München (D); K. Scholz, GeorgFischer Automotive, Schaffhausen (CH)</i>	291

Determination of Material Properties and Numerical Simulation to Predict the Mechanical Performance of Die Casted Components <i>M. Wuth, E. Lieven, PETRI AG, Aschaffenburg (D);</i> <i>W. Böhme, Fraunhofer-Institut für Werkstoffmechanik (IWM), Freiburg (D)</i>	296
Fatigue Design with Cast Magnesium Alloys <i>C. M. Sonsino, K. Dieterich, L. Wenk, Fraunhofer-Institute for Structural Durability (LBF), Darmstadt (D);</i> <i>A. Till, German Foundrymen's Association, Düsseldorf (D)</i>	304
Isothermal Fatigue of Magnesium Wrought Alloy AZ31 <i>U. Noster, I. Altenberger, B. Scholtes, Institute of Materials Technology, University Gh Kassel (D)</i>	312
Characterisation of Precipitate Phases in WE54 and AZ91 Alloys <i>J. F. Nie, Department of Materials Engineering, Monash University, Clayton (AUS);</i> <i>X. L. Xiao, C. P. Luo, Department of Mechano-Electronic Engineering, South China University of Technology, Guangzhou (VRC)</i>	318
Compression Test on Magnesium Alloy MgAl ₃ Zn at High Strain Rates and Temperatures <i>E. El-Magd, M. Abouridouane, Department of Materials Science, RWTH Aachen (D)</i>	324
Wear Behaviour of Laser Surface Treated Magnesium Alloys <i>U. Kutschera, DLR Stuttgart (D);</i> <i>R. Galun, IWW, TU Clausthal (D)</i>	330
Mechanical Behavior and Residual Stresses in AZ31 Wrought Magnesium Alloy Subjected to Four Point Bending <i>J. P. Nobre, M. Kornmeier, A. Dias, Department of Mechanical Engineering, University of Coimbra (P);</i> <i>U. Noster, J. Gibmeier, I. Altenberger, B. Scholtes, Institut of Materials Technology, University Gh Kassel (D)</i>	336
Superplasticity of Magnesium-Based Alloys <i>U. Draugelates, A. Schram, C.-C. Kedenburg, Institute of Welding and Machining, (ISAF), Clausthal (D)</i>	342
Cyclic Deformation Behavior of the Cast Magnesium Alloy AZ91 <i>H. W. Höppel, G. Eisenmeier, B. Holzwarth, H. Mughrabi, Institut für Werkstoffwissenschaften, Universität Erlangen-Nürnberg, Erlangen (D)</i>	348
Deformation Twinning of AZ31 Alloy in Quasistatic and Dynamic Compression Tests <i>E. Lach, A. Bohmann, M. Scharf, ISL, French-German Research Institute of Saint-Louis (F);</i> <i>U. Kainer, GKSS Research Centre – Geesthacht (D)</i>	354
Deformation and Fracture Behavior of Magnesium Structural Components <i>A. Ockewitz, C. Schendera, D.-Z. Sun, Fraunhofer-Institut für Werkstoffmechanik (IWM), Freiburg (D);</i> <i>B. Grosser, A. Hamann, Volkswagen AG Wolfsburg (D)</i>	359

Internationalization of Magnesium Research Through USCAR in North America and EUCAR in Europe <i>G. Cole, Ford Motor Company Research Laboratories, Dearborn, MI (USA)</i>	365
---	-----

Application

High-speed-drilling in AZ91 D without lubricoolants <i>F. Tikal, M. Schmier, Universität Gesamthochschule Kassel (D); C. Vollmer, Volkswagen AG Wolfsburg (D)</i>	373
--	-----

Design, Optimization and Reliability of Magnesium Safety Vehicle Parts <i>Y. Tzabari, Israel Institute of Metals, Technion, Israel Institute of Technology, Haifa (IL); I. Reich, Y. Bahalul, Ortal Diecasting LTD. Kibbutz Neve-Ur (IL)</i>	380
---	-----

Development and Production of a Die-cast Magnesium Convertible Soft-top Cover <i>P. Geist, F. Lehnert, BMW Group München (D); U. Kwasny, EDAG AG Munich (D)</i>	387
--	-----

Magnesium Motorcycle Wheels for Racing Applications <i>K. J. Schemme, Otto Fuchs Metallwerke, Meinerzhagen (D)</i>	391
---	-----

Weight and Cost Saving with Magnesium Die Castings <i>A. Mertz, Honsel GmbH & Co KG, Meschede (D)</i>	397
--	-----

Cast Magnesium Alloys For Wide Application <i>P. G. Detkov, I. Yu. Mukhina, A. D. Zhirnov, Solicamsk Magnesium Works, All-Russian Institute of Aviation Materials (RUS)</i>	402
--	-----

Improving the Characteristics of Magnesium Workpieces by Burnishing Operations <i>H. K. Tönshoff, T. Friemuth, J. Winkler, C. Podolsky, Institute for Production Engineering and Machine Tools, University of Hannover (D)</i>	406
---	-----

Machining of Light-Metal Matrix Composites <i>K. Weinert, M. Lange, M. Schroer, Institut für Spanende Fertigung, University of Dortmund (D)</i>	412
--	-----

Nitriding of Pressure Die Casting Dies and Tool Elements <i>H. R. Schmauser, Drei-S-Werk, Schwabach (D)</i>	418
--	-----

Corrosion and Surface Treatment

Corrosion Behaviour of the Microstructural Constituents of AZ Alloys <i>G. Song, A. Atrens, D. StJohn, L. Zheng, Department of Mining, Minerals and Materials Engineering, The University of Queensland, Brisbane (AUS)</i>	425
--	-----

Corrosion Properties of Die Cast AM Alloys <i>M. Videm, J. I. Skar, P. Bakke, Norsk Hydro Research Centre, Porsgrunn (N)</i>	432
---	-----

Improved Corrosion and Oxidation Resistance of AM and AZ Alloys by Ca and RE Additions <i>H. Alves, U. Köster, Dept. Chem. Eng., University of Dortmund (D)</i>	439
--	-----

Corrosion Behavior of thin Wall Magnesium Products Molded by Thixomolding <i>I. Nakatsugawa, H. Takayasu, K. Saito, The Japan Steel Works, Ltd. (J)</i>	445
Effect of Foundry Processing on the Corrosion Performance of High Purity Magnesium Sand Casting Alloys <i>H. Karimzadeh, Magnesium Elektron, Manchester (GB)</i>	451
Corrosion of the Magnesium Alloy AZ91 and its Influence on Fatigue Properties <i>C. Müller, R. Koch, Institut für Materialwissenschaft, Technische Universität Darmstadt (D); G. H. Deinzer, Adam Opel AG Internationales Technisches Entwicklungszentrum, Rüsselsheim (D)</i>	457
Effect of MEchanical Surface Treatment and Environment on Fatigue of Wrought Magnesium Alloys <i>M. Hilpert, L. Wagner, Chair of Physical Metallurgy and Materials Technology, Technical University of Brandenburg at Cottbus (D)</i>	463
Phosphate-Permanganate: A Chrome Free Alternative for Magnesium Pre-treatment <i>J. I. Skar, D. Albright, Norsk Hydro ASA, Porsgrunn (N)</i>	469
Alternatives to Cr(VI) Conversion Coatings for Magnesium Alloys <i>I. Azkarate, P. Cano, A. Del Barrio, M. Insausti, P. Santa Coloma, Fundación INASMET, San Sebastián (P)</i>	475
Surface Treatments for Large Automotive Magnesium Components <i>G. Guerci, C. Mus, TEKSID S.p.A., (I); K. Stewart, Meridian GTC (CND)</i>	484
Coating System for Magnesium Diecastings in Class A Surface Quality <i>R. Gadow, D. Scherer, Institute for Manufacturing Technologies of Ceramic Components and Composites, University of Stuttgart (D); F. J. Gammel, DaimlerChrysler AG, München (D); F. Lehnert, BMW Group München (D); J. I Skar, Norsk Hydro ASA, Porsgrunn (N)</i>	492
Corrosion Fatigue and Corrosion Creep of Magnesium Alloys <i>A. Eliezer, E. M. Gutman, E. Abramov, Y. Unigovski, E. Aghion, Dept. of Materials Engineering, Ben-Gurion University of the Negev, Beer-Sheva (IL)</i>	499
Corrosion Resistance of Die Casting AZ91D Magnesium Alloys in the Atmosphere <i>H. Umehara, National Institute of Materials and Chemical Research, Tsukuba, Ibaraki (J); M. Takaya, Chiba Institute of Technology, Narashino, Chiba (J), ; T. Itoh, Japan Weathering Test Center, Choshi, Chiba (J)</i>	506
Fabrication of Pure Magnesium Films on Magnesium Alloys by Vapor Deposition Technique <i>H. Tsubakino, A. Yamamoto, S. Fukumoto, Himeji Institute of Technology, Himeji (J); A. Watanabe, Graduate student of Himeji Institute of Technology (J)</i>	514

Corrosion Creep of Magnesium and Die-Cast Magnesium Alloys <i>E. M. Gutman, Y. Unigovski, A. Eliezer, E. Abramov, Dept. of Materials Engineering, Ben-Gurion University of the Negev, Beer-Sheva (IL)</i>	519
Response of Light Alloys to Mechanical Surface Treatments: Comparison of Magnesium and Aluminum Alloys <i>M. Hilpert, L. Wagner, Chair of Physical Metallurgy and Materials Technology, Technical University of Brandenburg at Cottbus (D)</i>	525
Processing	
The Fundamentals of the New Rheocasting – Process for Magnesium Alloys <i>H. Kaufmann, Leichtmetall Kompetenzzentrum Ranshofen (A); P. J. Uggowitzer, Swiss Federal Institute of Technology, ETH Zürich (CH)</i>	533
High Performance Die Castings - Utilizing Magnesium's Properties <i>T. Aune, Norsk Hydro ASA, Porsgrunn (N); H. Westengen, D. Albright, Norsk Hydro ASA, Porsgrunn (N)</i>	540
Optimized Development for Magnesium Castings and Casting Processes; Increase in Value by Applying a Closed Process Chain for the Development of Automotive Magnesium Castings <i>G. Hartmann, A. Egner-Walter, MAGMA Gießereitechnologie GmbH, Aachen (D)</i>	548
Thin-walled Mg Structural Parts by a Low-pressure Sand Casting Process <i>F. J. Edler, G. Lagrené, Honsel Fonderie Messier, Arudy (F); R. Siepe, Honsel GmbH & Co KG, Meschede (D)</i>	553
Quality Index Charts for Mg-based Casting Alloys <i>C. H. Cáceres, Department of Mining, Minerals and Materials Engineering, The University of Queensland, Brisbane (AUS)</i>	558
Magnesium Adapted Continuous Casting Technology <i>U. Holz-kamp, H. Haferkamp, M. Niemyer, Institut of Materials Science, University of Hanover (D)</i>	564
Microstructure Evolution and Mechanical Properties of AZ91 Mg Foams <i>C. Wen, Y. Yamada, K. Shimojima, M. Mabuchi, M. Nakamura, T. Asahina, National Industrial Research Institute of Nagoya (J); T. Aizawa, The University of Tokyo, Tokyo (J); K. Higashi, Osaka Prefecture University, Osaka (J)</i>	571
Semi Solid Injection Molding of MagnesiumAlloys <i>A. Dworog, Gerhard-Mercator-Universität Duisburg (D); M. Kothen, D. Hartmann, EFU Gesellschaft für Ur-/Umformtechnik mbH, Simmerath (D); K. Kuhmann, C. Boehnke, Hengst Filterwerke GmbH & Co. KG, Münster (D)</i>	577

Characterization of Melt Spun Mg-Ca-Zn Alloys

- P. M. Jardim, I. G. Solórzano, Department of Material Science and Metallurgy, PUC-Rio, Rio de Janeiro (BR);*
J. B. Vander Sande, Department of Material Science and Engineering – MIT, Cambridge, MA (USA);
B. S. You, W. W. Park, Korea Institute of Machinery & Materials, Changwon, Kyungnam (ROK).....584

Properties and Perspectives of Magnesium Rolled Products

- J. Enss, T. Everetz, T. Reier, P. Juchmann, Salzgitter AG Steel and Technology, Salzgitter (D).....590*

Microstructure, Mechanical Properties And Deformation Behaviour of Extruded Magnesium Alloys

- K. U. Kainer, GKSS Research Centre – Geesthacht (D);*
E. Doege, S. Janssen, Institute for Metal Forming and Metal Forming Machine Tools, University of Hanover (D);
T. Ebert, Department of Materials Science and Engineering, Technical University of Clausthal (D)596

Properties and Processing of Magnesium Wrought Products for Automotive Applications

- W. Sebastian, K. Dröder, S. Schumann, Volkswagen AG Wolfsburg (D).....602*

Hydrostatic Extrusion of Magnesium

- K. Savage, J. F. King, Magnesium Elektron, Manchester (GB);*
A. van Kooij, HME, Holland (NL).....609

Deep Drawing of Magnesium Sheet Metal at Room Temperature

- H.-W. Wagener, Metal Forming Laboratory, University of Kassel (D);*
F. Lehnert, Bayerische Motoren Werke AG, München (D)615

Hot and Cold Forming Behaviour of Magnesium Alloys AZ31 and AZ61

- L. Chabbi, W. Lehnert, R. Kawalla, Institute of Metal Forming, Freiberg University of Mining and Technology, Freiberg (D);*
F. Lehnert, BMW Group München (D).....621

Suppression of Mold-Metal Reactions during Investment Casting

- M. H. Idris, A. Ourdjini, E. Hamzah, Universiti Teknologi Malaysia, Johor (MAL);*
A. Clegg, Loughborough University, Loughborough (GB)628

Microstructure and Mechanical Properties of Melt-quenched Mg-Gd-(Ni, Cu or Zn) Alloys

- K. Matsuzaki, M. Takahashi, T. Sano, Mechanical Engineering Laboratory, Tsukuba (J).....635*

Simulation of Open-cell Magnesium Foams under Dynamic Loading

- K. Shimojima, M. Mabuchi, Y. Yamada, C. E. Wen, Y. Chino, M. Nakamura, T. Asahina, Materials Processing Department, National Industrial Research Institute of Nagoya (J);*
T. Aizawa, Department of Metallurgy, The University of Tokyo, (J);
K. Higashi, Department of Metallurgy and Materials Science, Osaka Prefecture University, Gakuen-cho, Sakai, Osaka (J).....639

Processing of Cellular Magnesium Alloy <i>Y. Yamada, C. Wen, K. Shimojima, M. Mabuchi, M. Nakamura, T. Asahina, National Industrial Research Institute of Nagoya (J); T. Aizawa, The University of Tokyo, Tokyo (J); K. Higashi, Osaka Prefecture University, Osaka (J)</i>	645
Semi-solid Forming of New Mg-Zn-Al-Ca Alloys <i>S. Kamado, N. Ikeya, R. Suhardi Rudi, T. Araki, Y. Kojima, Department of Mechanical Engineering, Nagaoka University of Technology, Nagaoka (J)</i>	651
Physical Properties	
Damping in Magnesium and Magnesium Alloys <i>W. Riehemann, Institut für Werkstoffkunde und Werkstofftechnik der TU Clausthal (D)</i>	659
Thermal Diffusivity and Thermal Conductivity of Mg Alloys <i>A. Rudajevová, P. Lukác, Department of Metal Physics, Charles University, Praha (CZ)</i>	665
Experimental Determination of Interfacial Heat Transfer Coefficient for AZ91E Castings <i>S. Bergeron, M. Lepage, J. Renaud, INTERMAG Technologies Inc., Sainte-Foy (CND); D. Dubé, V. Lambert, Dept. of Mining and Metallurgy, Laval University, Sainte-Foy (CND)</i>	671
Stress Relaxations in a Magnesium Alloy and Composite <i>Z. Trojanová, P. Lukác, Department of Metal Physics, Charles University, Praha (CZ); W. Riehemann, Department of Materials Engineering and Technology, Technical University Clausthal (D); F. von, Volkswagen AG Wolfsburg (D)</i>	678
Creep Behaviour	
Tensile and Compressive Creep Behavior of Magnesium Die Casting Alloys Containing Aluminum <i>S. R. Agnew, S. Viswanathan, E. A. Payzant, Q. Han, K. C. Liu, E. A. Kenik, Oak Ridge National Laboratory, Oak Ridge, Tn (USA)</i>	687
Creep of Mg-Zn-Al-Alloys <i>M. Vogel, O. Kraft, E. Arzt, Max-Planck-Institut für Metallforschung, Stuttgart (D); E. D. Reese, R. Rauh, DaimlerChrysler AG, München (D)</i>	693
Creep Behavior and Deformation Substructures of Thixomolded Mg-Al-Ca Alloys <i>M. Suzuki, J.-I. Koike, K. Maruyama, H. Kubo, Tohoku University, Tohoku (J); T. Tsukeda, K. Saito, The Japan Steel Works, Ltd. (J)</i>	699
Creep and Bolt-Load Retention of Sand Cast Elektron MEZ <i>C. J. Bettles, CSIRO Manufacturing Science and Technology, Victoria (D); M. S. Dargusch, The University of Queensland (AUS)</i>	705

The Microstructure and Creep of an Extruded Mg-Y-Nd Alloy <i>P. Azari-Khosroshahi, Semnan University, Semnan (IR)</i>	711
Microstructure and Creep Properties of Die-cast Mg-Al-base Alloys AZ91 and AS21 <i>P. Zhang, R. Agamennone, W. Blum, Institut für Werkstoffwissenschaften, Universität Erlangen-Nürnberg, Erlangen (D); B. von Grossmann, H.-G. Haldenwanger, Audi AG, Ingolstadt (D)</i>	716
Recycling, Melting, Environmental	
Magnesium Melting / Casting and Remelting in Foundries <i>H. W. Dörsam</i>	725
The Impact of Metal Cleanliness on Mechanical Properties of Die Cast Magnesium Alloy AM50 <i>P. Bakke, K. Pettersen, S. Guldborg, S. Sannes, Norsk Hydro Research Centre, Porsgrunn (N)</i>	739
Remelting and Cleaning of Magnesium Scrap <i>U. Galovsky, M. Kühlein, Leichtmetall Kompetenzzentrum Ranshofen (A)</i>	746
Utilization of Residues from Fluxless Remelting of Compact Magnesium Scrap <i>A. Ditzel, C. Scharf, Institut für Metallurgie, Technische Universität Clausthal (D)</i>	752
Use of SO ₂ as Protection Gas in Magnesium Diecasting <i>W. Schubert, LM Leichtmetall-Systemtechnik GmbH, Fellbach (D); H. Gjestland, Hydro Magnesium, Porsgrunn (N)</i>	761
Impurities in Magnesium and Magnesium Based Alloys and their Removal <i>H. Singh Tathgar, T.A. Engh, Norwegian University of Science and Technology, Trondheim (N); P. Bakke, Norsk Hydro Research Centre, Porsgrunn (N)</i>	767
Simulation	
An Approach to Determine Solidification Curves of Commercial Magnesium Alloys <i>D. Mirkovic, J. Gröbner, R. Schmid-Fetzer, Institute of Metallurgy, Technical University of Clausthal (D)</i>	783
Author Index	789
Subject Index	793