

RESEAU FRANÇAIS DE MECANOSYNTHESE

Lettre N°44

Novembre 1998

128 (+3) Groupes de Recherche
(dont 64(+2) à l'étranger)

Bureau : E. Gaffet (Président), G. Le Caër (Secrétaire Général), A.R. Yavari (Trésorier)

3 Nouvelles Adhésions :

XiaoBao Fan - Nanomaterials Research Corporation - USA
G.F. Goya - lab. de Materials Magnetics - Univ. Sao Paulo - Brésil
V. Nivoix - Univ Rouen - France

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JRFM'99

4 èmes Journées du Réseau Français de Mécanosynthèse
Dijon, les 2-3 Juin 1999
1ère circulaire

Programme des JRFM'99

- 3 conférenciers invités sont d'ores et déjà programmés :
- D.LOUER (Directeur de Recherches CNRS- Rennes).
 - JF.BERAR (Ingénieur de Recherches CNRS- Grenoble / ESRF).
 - J.C.MUTIN (Directeur de Recherches CNRS - Dijon).

Appel à Communications

à renvoyer avant le **30 Décembre 1998**

Nom:Prénom:

Adresse:.....

.....
Téléphone : Fax :E-mail :

Souhaite présenter une communication lors des JRFM99 sous forme de :
communication orale Communication par affiche

Titre :

Fiche d'inscription à retourner à

Frédéric BERNARD (Journées RFM99), Laboratoire de Recherches sur la Réactivité des Solides (UMR5613 CNRS - Université de Bourgogne), 9 avenue Alain Savary, BP 400, 21011 Dijon Cedex. (Tel : 03.80.39.61.25 - fax : 03.80.39.61.67, E-mail : fbernard@u-bourgogne.fr)

Comité d'organisation :

Frédéric Bernard et toute l'équipe " Matériaux à Grains Fins " :
Laboratoire de Recherches sur la Réactivité des Solides (UMR5613 CNRS
Université de Bourgogne), 9 avenue Alain Savary, BP 400, 21011 Dijon Cedex.
Tel : 03.80.39.61.25 - Fax : 03.80.39.61.67, E-mail : fbernard@u-bourgogne.fr)
Eric Gaffet :
Président du Réseau Français de Mécanosynthèse
Groupe "Nanomatériaux" - CNRS UPRA423/806 - Institut Polytechnique de Sévenans
90100 Belfort Cedex.
Tél : 03 84 58 31 02 - Fax : 03 84 58 30 27 - E-mail : Eric.Gaffet@utbm.fr

Les différentes propositions recues pour la conférence ISMANAM98 sont désormais en ligne sur le site web de la conférence :

<http://www.uow.edu.au/conferences/ismanam98>

!!!!

Le site web du RFM est le suivant

<http://www.bls.fr/amatech>

Rubrique Pages Sciences et Techniques pour l'Ingénieur (Rubrique Sciences)

⇒ vous y trouverez les anciennes lettres du RFM (accessible par Adobe Acrobat)

les statuts du RFM ainsi que les annonces concernant les JRFM'99 et quelques éléments mis à jour régulièrement concernant les derniers résultats dans ce domaine.

Le Site Web du RFM a été consulté plus de 250 fois

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A noter l'ouverture sur ce site

d'un Forum

permettant de discuter sur tout sujet

"Mécanosynthèse et/ou Nanomatériaux"

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**ANNONCE DE CONGRES ET / OU ECOLES
CONGRESS AND SCHOOL ANNOUNCEMENTS**

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All the details may be obtained by E-Mail to E. Gaffet

Fifth Internation Symposium on Quatum Confinement : Nanostructures

194th Meeting of the Electrochemical Society

1 - 6 Novembre 1998 - Boston - MA - USA

<http://www.electrochem.org>

Fine, Ultrafine and Nano Powders '98

Crowne Plaza Hotel - LaGuardia Airport - 8 - 10 Novembre 1998

Contact : E-Mail : Tombcc@aol.com

Sixth Foresight Conference

on Molecular Nanotechnology

Westin Hotel - Santa Clara - 12 15 Novembre 1998

California Satellite Conference to Nano'98

Contact : E-Mail : globus@nas.nasa.gov

Symposium on Advanced Technologies for Particle Production

AICHE Annual Meeting

15 - 20 November - Miami Beach - FL - USA

Technical Sessions and ChairPersonns

1/ Particle Synthesis in Dispersions and Supercritical Fluids-R. Davis/MT Harris/D. Tomasko

2/ Sol - Gel Synthesis of Particles - A McCormick/PN Kumta/T. Okubo

3/ Chemical Kinetics during Particle Formation - J. Floess, K. Higashitani, S. E. Pratsinis

4/ In-Situ Diagnostics during Particle Formation-Ph. W. Morrison,R.M. Carangelo, D.T. Spicer

5/ Agglomerate Particle Dynamics - G. Fotou, SK Friedlander, Takahashi

6/ Computational Fluid Dynamics during Particle Formation and Growth - L. Collins, K. Kontomaris

7/ Aerosol Reactors - A.W. Weimer, M. Kamal Akhtar

8/ Particle Charging - T. Matsoukas

9/ Film synthesis by Particle Technologies - G. Grader, S. Bhandarkar

10/ Nanoparticles - M. Senna, TJ Mountziaris, H. Glicksmn

11/ Particulate deposits : Transport mechanisms, microstructure and properties : D. Rosner

12/ Posters on Advanced Technologies for Particles Production : G. Beaucage, H. Riemenschneider

Web Site : www.aiche.org

ISMANAM98

International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials

Wollongong (Sydney) - Australie - 7 - 12 Décembre 1998

International Advisory Committee :

V.V. Boldyrev, R.W. Cahn, S. Enzo,H. Fecht, E. Gaffet, A. Garcia - Escorial, A.L. Greer, E.Y. Gutmanas,

K. Lu, M. Mammoun, M.T. Mora, H. Mori, M.A. Morris, L. Schultz, M. Senna, A. Slawska - Waniewska,

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Contact : A. Calka E-Mail : Andrzej_Calka@uow.edu.au et

WebSite : <http://www.uow.edu.au/conferences/ismanam98>

Satellite Symposium on Mechanochemistry / ISMANAM98
(Mechanochemical Synthesis and Mechanochemistry)

Wollongong - Australie 7 /12 Decembre 1998

International Advisory Committee :

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E. Gaffet, E. Gutman, M. Senna, C. Suryanaryana, R. Schwarz

WebSite : <http://www.uow.edu.au/conferences/ismanam98>

Nanostructured Hybrid Materials

Symposium TMS Annual Meeting - San Diego CA - USA - 28 Février 4 Mars 1999

Contact : gmchow@anvil.nrl.navy.mil

Nouveau	XXV JEEP Journées d'Etudes des Equilibres entre Phases 1999 11 - 12 Mars 1999 - Annecy France E-Mail : Conference.Jeep@univ-savoie.fr
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Nouveau	VII International Seminary Defects, structure and properties of Nanocrystalline Materials obtained by Nanocrystallization of Amorphous Solids and of Metals with Extreme Distortion of the Lattice Mars 1999 - Ekaterinburg - Russie E-Mail : Noskovaimp.uran.ru
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Nouveau	Nanocomposite Materials : Design and Applications 28 Mars - 2 Avril 1999 - Alyeska Resort - Alaska E-Mail : Engfnd@aol.com
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4th International Workshop on Metastable Phases (IV IWOMP)

7 - 9 Avril 1999 - Bologne - Italie

Contact : Bonetti@df.unibo.it

12th International Conference on Wear of Materials

Atlanta - Georgie / USA - 25 - 29 Avril 1999

contact : Amy Richardson E-Mail A.Richardson@elsevier.co.uk

or web site : <http://www.elsevier.nl/locate/wom99>

Nouveau	E MRS - Spring Meeting 1 - 4 Juin 1999 - Strasbourg - France Web Site http://www-emrs.C-strasbourg.fr Symposium A : Phot - Excited Process and Applications Symposium B : Protective Coating and Thin Films 99 Symposium C : Progress in Computational Materials Science Symposium D : Plasma and Ion Surface Engineering Symposium E : Advanced Silicon Substrates Symposium F : Process induced defects in Semiconductors Symposium G : Material Physics Issue and Applications on Magnetic Oxides Symposium H : Strain in Materials : Analysis, Relaxation and Properties Symposium I : Microcrystalline and Nanocrystalline Semiconductors Symposium J : Materials for Coherent Optics Symposium K : Materials, Process and Technology for Optical Interconnect Symposium L : Ab - Initio Approaches to Microelectronics Materials... Symposium M Basic Models to enhance Reliability in Si based devices and .. Symposium N : Molecular Optoelectronics : Materials, Physics and Devices Symposium O : Chalcogenide Semiconductors for Photovoltaics Symposium P : Optical Characterization of Semiconductor layers and Surfaces
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JRFM'99

4èmes Journées du RFM

2 & 3 Juin 1999 - Dijon - France

Web Site : <http://www.bls.fr/amatech> - Web SubSite : Sciences

**Nanostructured Materials Symposium at the 5th IUMRS International Conference
on Advanced Materials**
(IUMRS - ICAM'99)

Beijing - Chine - 13 - 18 Juin 1999

Contact : Kelu@imr.ac.cn

WebSite - <http://www.chimeb.edu.cn>

PM2 Tec 98
1999 International Conference
on Powder Metallurgy and Particulate Materials
Vancouver - 20 / 24 Juin 1999
E_Mail : Info@mpif.org - Website: www.mpif.org

Nouveau	4th Int. Conf. on Materials Chemistry 13 - 16 Juillet 1999 - Trinity College _ Univ. Dublin - Irlande Web Site : http://www.rsc.org/conferences Themes : Inorganic Nano and Micro Particles Fucntional Polymers Magnetic Materials Organic Nanostructures Molecular Crystals and Crystal Engineering Computational Chemistry and Materials for Electronic
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Nouveau	NATO Advanced Research Workshop Investigations and Applications of Severe Plastic Deformation 2 - 6 Aout 1999 - Moscu - Russie E_Mail : TLow@lanl.gov and Valiev@ippm.rb.ru
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10th International Conference on Rapidly Quenched and Metastable Materials (RQ10)
Bangalore - Inde - 23 - 27 Août 1999
Wesite : <http://www.metalrg.iisc.ernet.in/rqten/>

Nouveau	SMM14 14th International Conf. on Soft Magnetic Materials 8 - 10 Septembre 1999 Balatonfüred - Hongrie web site : http://www.kfki.hu - Subsite : smm14
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Nouveau	Int. Symp. Cluster and Nanostructure Interfaces (ISCANI) 25 - 29 Octobre 1999 - Richmond USA website : http://www.vcu.edu/ISCANI/
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Annonces de Soutenance de Thèses
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Synthese et Propriétés de Ferrites Nanométriques : Influence de l'énergie de surface sur les propriétés structurales et magnétiques de ferrites de titane synthétisés par chimie douce et mécanosynthèse
N. Guigue - Millot - 26 Novembre 1998 - LRRS UMR 5613 CNRS - Univ. Bourgogne - Dijon - France
Jury : J. Etourneau, A. Rousset, G. Bertrand, D. Stuerger, G. Le Caër, M. Guyot, O. Isnard, P. Perriat

Transformations antiferromag - ferromag - paramagnétiques - verre de spin dans les alliages de Fe Rh nanocristallisés par Broyage
E. Navarro - Universie de Complutense - Madrid - Espagne - 18 Mai 1998
Co directeurs : A. Hernando - A.R. Yavari

Modifications morphologiques et microstructurales du matériau actif des cathodes de batteries à l'ion lithium induites par broyage et traitement thermique
Ph. Perrot - Université de Poitiers - 6 Mai 1998
Co - Directeurs : E.L. Mathe, M. Grosbras
Jury : J. Mimault, H. Van Damme, A. Dager, M. Broussely, P. Goudeau, E.L. Mathe, M. Grosbras

Effects of the mechanical milling on carbons : negative electrode materials of Li - ion batteries"
F. Salver Disma - Université de Picardie Jules Verne - 4 Février 98
Jury : Aymard L., Beguin F., Coulon M., Furdin G, Lassegues JC, Percheron Guegan A., Rouzaud JN, Tarascon JM.

"Elaboration et Caractérisations de Cermets Alumine - Métal à partir de poudres obtenues par Mécanosynthèse"
J.-L. Guichard - INPL - Nancy - 23 Janvier 1998
Jury : A. Simon, C. Carry, F. Thévenot, G. Le Caër, A. Mocellin

"Spinelles nanométriques à valence mixte et à fort taux de lacunes cationiques : Transfert électroniques dans un ferrite de molybdène Fe_{2.47}Mo_{0.53}O₄, de la synthèse aux propriétés magnétiques dans le système fer - vanadium Fe_{3-x}V_xO₄ (0²x<2).
V. Nivoix - Université de Bourgogne - 17 Décembre 1997
Jury : M. Lenglet, H. Pascard, G. Bertrand, E. Gaffet, M. Guyot, M. Lallemand, A. Rousset, B. Gillot

"The Preparation of Nitrides and Carbides by Mechanical Treatment - Phases and Structures"

G.M. Wang - School of Physics, University College, The University of New South Wales - Australian Defence Force Academy - Canberra, ACT 2600 - Australia - 10/12/97

Supervisor - S.J. Campbell - Co - Supervisors : W.A. Kaczmarek and A. Calka

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"Suivi par Diffraction X en Temps Réel de la Formation par Combustion des intermétalliques des systèmes Al - Ni, Al - Ti, Al - Ni - Ti"

J. F. Javel - Université de Nancy I - 3 Octobre 1997

Jury : J.F. Berar, F. Bernard, M. Bessiere, M. Dirand, J.C. Gachon, P. Galez, J.C. Jorda

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"Contribution à l'Etude de la Transformation - Tribologique Superficielle en Fretting"

E. Sauger - Ecole Centrale de Lyon - Génie des Matériaux - 26 Septembre 1997

Jury : L. Mora - Ponsonnet, P. Blanchard, K. Dang Van, C. Esnouf, E. Gaffet, E. Rosset, A.B. Vannes, L. Vincent

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Sites internet à découvrir

Site sur la cristallographie / Soft + Littérature

<http://www.lmcp.jussieu/sincris-top/logiciel>

N.B. : si vous connaissez d'autres sites en relation avec les thèmes développés par le RFM, faites nous les connaître

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Post Doc Position Proposals

Belgique

The Department Metallurgy and Materials Engineering (MTM) of the K.U.Leuven (Belgium) has a research position available. Candidates are asked to contact the responsible staff member.

Area of research :

Metals and Alloys, Polymer Matrix Composites, Intelligent Processing of Materials, Surface Engineering and Tribology, Metal Forming and Mechanical Behaviour of Materials, Quality Control and Non-Destructive Testing of Materials, Ceramics, Thermodynamics, Corrosion, Nuclear Engineering

Description of research task

Tailor made powders by mechanical alloying of Fe and Cu based materials. Application field: specific composite materials, to be prepared by conventional PM consolidation techniques. Research activities: parametric study of MA, alloy design, microscopic

Staff member to be contacted

Prof. Dr. Ir. L. Froyen

Katholieke Universiteit Leuven - Dept. MTM

de Croylaan 2 - B-3001 Leuven (Belgium)

Tel. +32/16/22.09.31

Japon

Our group: Nanocomposite Group, Department of Composite Materials, National Institute of Materials and Chemical Research, Tsukuba, Ibaraki, Japan

is now looking for post-doc researchers

The candidates would be integrated in the Nanocomposite Group of the Department of Composite Materials. The research interests of the group are mainly focused on nanocomposite preparation and its optical/chemical functionalities. Research projects currently under way aim to develop nanostructured and optically/chemically active thin films by sputtering, laser ablation and so on. For additional information about the Institute and group :

<http://www.nimc.go.jp/>

<http://www.aist.go.jp/NIMC/fcg/index.html>

Experience in the fields of materials science (ceramic or metal) is required.

There are two types of post-doc positions.

1. Long-term: from 6 months to 2 years

2. Short-term: from 1 to 3 months

If you or someone in your laboratory is interested in this fellowship, please contact as soon as possible to:

Dr. Naoto Koshizaki - Department of Composite Materials

National Institute of Materials and Chemical Research(NIMC) 1-1 Higashi, Tsukuba, Ibaraki 305-8565 JAPAN

Tel: +81-298-54-6335 - Fax: +81-298-54-6252 - E-mail: koshizaki@nimc.go.jp - <http://www.aist.go.jp/NIMC/fcg/index.html>

Bibliographie Récente

Livres ou "Special Issues"

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Brazilian Journal of Materials Science and Engineering

We are pleased to invite you to publish in the technical journal **BJMSE**.

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Some papers of first issue are:

CHEMISTRY FOR SUSTAINABLE DEVELOPMENT

Vol. 6, No. 2-3, MARCH-JUNE 1998

Proceedings of 2d International Conference on Mechanochemistry (INCOME-2), which was held in Novosibirsk in 1997.

Contact : Prof. • N.Z. Lyakhov, Inst. Sol. State Chem.- Russian Acad Sci. - Kutaleladze, 18 - Novosibirsk - 630128 Russia - The Proceedings will be available by the price 80 USD.

Mechanochemistry of Materials Cambridge International Science Publishing

Emmanuel Gutman - Materials Eng. Dpt - Ben Gurion University - Beer Sheva - Israel

Considerable advances have been made in mechanochemistry in the last couple of decades. Training of experts in this field with a background in materials science, chemical and mechanical engineering, etc. requires study of the fundamentals of mechanochemistry. There is a need for a textbook in the general and compressed form which would cover many aspects and would be used as a basis for understanding the fundamental principles to control mechanochemical phenomena. This textbook is based on lectures given by Prof. Gutman in a graduate course in the mechanochemistry of materials at the Ben - Gurion University of the Negev. The book contains examples of experimental results to illustrate the mechanochemical phenomena and technologies.

BIBLIOGRAPHY ON MECHANICAL ALLOYING AND MILLING

Suryanarayana (Inst for Materials and Advanced Processes, University of Idaho, USA)

SPECIAL OFFER TO PARTICIPANTS OF ISMANAM-97. THIS UNIQUE BIBLIOGRAPHY IS AVAILABLE AT A REDUCED PRICE OF £50.00 (including postage and packing)

The present bibliography covers information on mechanical alloying and milling of materials starting from 1970 (when it was recognized that MA has become a commercial/viable material processing technique instead of just a grinding method) to 1996. All the available references will be presented in a chronological fashion. Under each year, the entries will be mentioned in an alphabetical order according to the first-named author. Each reference provides the listing of all the authors (in the sequence they appear in the publication), full title of the publication, source (journal, book chapter, conference proceedings, patent, etc.), volume, year of publication, page numbers (starting and ending) and language of the document, if it is not in English. A reference, wherever available, to the entry number under which this publication was abstracted by Metals Abstracts (jointly published by the ASM International and Institute of Materials) will be given so that the reader can have access to the abstract before looking up the original article for full details. These items will be followed by letter symbols to indicate the topics and properties discussed in that publication. A comprehensive author index, subject index, and material index, is also provided at the end of the bibliographic entries. 234x156 mm, 440 pages, cased, Price to ISMANAM-97 delegates £50, ISBN: 1898326126

Please send your order to: Book Department - Cambridge International Science Publishing 7 Meadow Walk, Great Abington, Cambridge CB1 6AZ, England Fax: +44 1223 894 539; tel +44 1223 893295, email: orders@cisp.demon.co.uk / Cambridge International Science Publishing <http://www.demon.co.uk/cambsci/homepage.htm>

Proceeding du Congrès "Mechanically Alloyed, Metastable and Nanocrystalline Materials"- Barcelone (1997)

Editor : M.D. Baro, S. Surinach - Materials Science Forum 269 - 272 (1998)

PERIODIQUES

(Rubrique assurée grâce au concours de M^{me} TAUZIN - FIN BiPSé)

N.B. : En cas de difficultés à vous procurer une copie des articles suivants,
n'hésitez pas à contacter E. Gaffet (CNRS / IPSé - Belfort)

[77] MICROSTRUCTURAL CHARACTERIZATION OF A HIGH CARBON FE-C ALLOY DURING ATTRITION MILLING AND SINTERING

Ovecoglu ML. Aslanoglu Z. Ozkal B. - International Journal of Powder Metallurgy. 34(6):47-56, 1998

Mechanical alloying of blended element powders of composition Fe-5w/oC was carried out in a heavy duty attritor for milling times of 1.5, 10, 20 and 30h followed by compaction, sintering and furnace cooling under industrial conditions. Changes in the morphology and the microstructures of the as-milled powders and the compacts were characterized by laser diffraction size analysis; x-ray diffractometry and transmission electron microscopy. Carbon content was measured by C-S techniques. The X-ray results are consistent with partial and complete amorphization of bcc alpha-Fe and graphite, respectively, in the powder alloy after long milling times. Notwithstanding substantial carbon depletion in the alloy at long milling times, carbon solubility in alpha-Fe, calculated by measured peak shifts in the X-ray spectra, increases. Morphologically, longer milling times resulted in composite powder particles with smaller sizes compared to those milled for shorter times. Consequently, higher densities and hardness values were achieved for compacts attritor-milled at longer times. Undissociated carbon stripes alpha-Fe and pearlite phases exist in the compacts milled from powder blends at shorter milling times; in contrast, irregular small patches of carbon regions surround the alpha-Fe grains for powders milled at longer times. Transmission electron microscopy revealed the presence of Fe₃C in the alpha-Fe matrix of the sintered compact prepared from powders milled for 20h.

[76] FORMATION OF NANOCRYSTALLINE CUBIC (L1(2)) TITANIUM TRIALUMINIDE BY CONTROLLED BALL MILLING

Varin RA. Wexler D. Calka A. Zbroniec L. - Intermetallics. 6(6):547-557, 1998

Pre-alloyed, as-cast ingots of the Mn-modified, cubic (L1(2)) titanium trialuminide (65 at% Al, 25.6 at% Ti and 9.4 at% Mn) were homogenized (1000 degrees C/100), crushed into a coarse-particle powdered material and subsequently ball milled for up to 386 h under shearing mode in a controlled ball movement mill. X-ray spectra of milled powders showed line broadening and decrease in intensity of Bragg peaks with increasing milling time. This is associated with the formation of nanocrystalline grains and lattice strains upon milling. Crystallite size calculated from peak broadening, remains relatively unchanged from 19 up to 100 h of milling (20-30 nm) and then drastically decreases reaching a saturation size of about 3 nm after 200 h of milling. Lattice strains are on the average less than 1%. Simultaneously, the ordered L1(2) crystal structure undergoes disordering which commences after approximately 40 h and terminates after 160 h of milling. The microstructure of powder particles undergoes a complex evolution. With increasing milling time the particles are formed which appear to contain a work-hardened core. Each such a particle is surrounded by a heavily deformed, hard outer layer containing nanometer grains. After 386 h of milling all the core/outer layer particles are transformed into uniform 'no core' ones, characterized by approximately 3 nm crystallite size (XRD measurements). The microhardness data for both outer layer in the powder particles with a core, and the 'no core' particles can be fitted by a Hall-Petch dependence on the inverse root of crystallite size: $HV\ 0.01 = 431.7 + 387.5d^{-0.5}$ (kg mm⁻²) where HV 0.01 is Vickers microhardness at 0.01 kg and d is crystallite size in nm. These results are discussed in view of the existing models of hardening of nanosized materials.

[75] NONEQUILIBRIUM PHASE TRANSFORMATION OF ND₂FE₁₁Ti COMPOUND DURING MECHANICAL MILLING

Tang SL. Wu CH. Wang BW. Jin XM. Li GS. Ding BZ. Chuang YC. - Journal of Magnetism & Magnetic Materials. 188(3):387-392, 1998

A nonequilibrium phase transformation in a stoichiometric Nd₂Fe₁₁Ti compound during mechanical milling was monitored by the measurements of AC susceptibility, magnetization, X-ray diffraction, and transmission electron microscopy. The sequence of nonequilibrium phase transformation has been identified as (I) the slow decomposition to mixtures of metastable Nd(Fe, Ti)(7) and alpha-Fe(Ti) phases and, finally, (II) amorphization of an Nd(Fe, Ti)(7) phase and formation of a mixture of an amorphous phase and supersaturated BCC solid solution of Ti in Fe.

[74] MECHANICAL BEHAVIOR OF A BULK NANOSTRUCTURED IRON ALLOY

Carsley JE. Fisher A. Milligan WW. Aifantis EC. - Metallurgical & Materials Transactions A-Physical Metallurgy & Materials Science. 29(9):2261-2271, 1998

Bulk, fully dense materials were prepared from Fe-10Cu with grain diameters between 45 nm and 1.7 μm. The materials were prepared by ball milling of powders in a glove box, followed by hot isostatic pressing (hipping) or powder forging. Larger grain sizes were obtained by thermal treatment of the consolidated powders. The bulk materials were relatively clean, with oxygen levels below 1500 wpm and other contaminants less than 0.1 at. pct. The mechanical behavior of these materials was unique. At temperatures from 77 to 470 K, the first and only mechanism of plastic deformation was intense shear banding, which was accompanied by a perfectly plastic stress-strain response (absence of strain hardening). There was a large tension-compression asymmetry in the strength, and the shear bands did not occur on the plane of maximum shear stress or the plane of zero extension. This behavior, while unusual for metals, has been observed in amorphous polymers and metallic glasses. On the other hand, the fine-grained Fe-10Cu materials behaved like coarse-grained iron in some respects, particularly by obeying the Hall-Petch equation with constants reasonably close to those of pure iron and by exhibiting low-temperature mechanical behavior which was very similar to that of steels. Transmission electron microscopy (TEM) studies found highly elongated grains within shear bands, indicating that shear banding occurred by a dislocation-based mechanism, at least at grain sizes above 100 nm. Similarities and differences between the fine-grained Fe-10Cu and metals, polymers, metallic glasses, radiation-damaged metals, and quench-damaged metals are discussed.

[73] EFFECT OF B ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF MECHANICALLY MILLED TiAl ALLOYS

Kim SH. Chung HH. Pyo SG. Hwang SJ. Kim NJ. - Metallurgical & Materials Transactions A-Physical Metallurgy & Materials Science. 29(9):2273-2283, 1998

The present study is concerned with γ -(Ti₅₂Al₄₈)(100-x)B-x (x = 0, 0.5, 2, 5) alloys produced by mechanical milling/vacuum hot pressing (VHPing) using melt-extracted powders. Microstructure of the as-vacuum hot pressed (VHPed) alloys exhibits a duplex equiaxed microstructure of α (2) and γ with a mean grain size of 200 nm. Besides α (2) and γ phases, binary and 0.5 pet B alloys contain Ti, AlN and Al₂O₃ phases located along the grain boundaries and show appreciable coarsening in grain and dispersoid sizes during annealing treatment at 1300 degrees C for 5 hours. On the other hand, 2 pet B and 5 pet B alloys contain fine boride particles within the γ grains and show minimal coarsening during annealing. Room-temperature compressing tests of the as-VHPed alloys show low ductility, but very high yield strength > 2100 MPa. After annealing treatment, mechanically milled alloys show much higher yield strength than conventional powder metallurgy and ingot metallurgy processed alloys, with equivalent ductility to ingot metallurgy processed alloys. The 5 pet B alloy with the smallest grain size shows higher yield strength than binary alloy up to the test temperature of 700 degrees C. At 850 degrees C, 5 pet B alloy shows much lower strength than the binary alloy, indicating that the deformation of fine 5 pet B alloy is dominated by the grain boundary sliding mechanism.

[72] A NOVEL WAY OF AMORPHOUS PHASE FORMATION DURING MECHANICAL ALLOYING OF COPPER AND CADMIUM POWDERS

Zhang DL. Massalski TB. - Metallurgical & Materials Transactions A-Physical Metallurgy & Materials Science. 29(9):2425-2432, 1998

Phase formation during high-energy ball milling of copper and cadmium powders has been investigated. Both X-ray diffractometry (XRD) and differential scanning calorimetry (DSC) have been used to characterize the resulting phases. An amorphous phase forms during milling in the copper-cadmium system by a reaction between the equilibrium δ phase and one of the constituent metals (copper). However, the amorphous phase cannot be produced by a direct reaction between the copper and cadmium powders, nor by milling of a powder consisting of only the δ phase. It appears most likely that the contribution from the generated copper/ δ interfaces, and the accompanying increase in the total free energy, provide the additional driving force for the amorphous phase formation in: this system.

[71] DEVELOPPEMENTS RECENTS DE L'ETUDE EN TEMPS REEL PAR DIFFRACTION DES RAYONS X COUPLEES A UNE THERMOGRAPHIE INFRAROUGE : APPLICATION AU SUIVI DE LA REACTION MASHS DANS LES SYSTEMES FeAl ET MOSI₂

F. Charlot, C. Gras, M. Gramond, E. Gaffet, F. Bernard, J.C. Niepce - J. Phys., IV (8) (1998) 497 - 504

The mechanical activation Self - Propagating High Temperature Synthesis (MASHS) processing is a new way to produce nanocrystalline iron aluminide or molybdenum disilicide compounds. This kind of reaction has been in situ investigated using the Time Resolved X - ray diffraction (TRXRD) with an X - ray synchrotron beam, coupling to an infrared thermography to follow in resolved time, structure transformation and temperature evolution. With short acquisition times, it has been possible to observe several steps before obtaining compound and to reveal the mechanical activation effect versus a classical SHS process.

[70] PROCESSING AND PROPERTIES OF INTERMETALLIC/CERAMIC COMPOSITES WITH INTERPENETRATING MICROSTRUCTURE

Klassen T. Gunther R. Dickau B. Gartner F. Bartels A. Bormann R. Mecking H. - Journal of the American Ceramic Society. 81(9):2504-2506, 1998

Intermetallic/ceramic composites represent an interesting class of materials for high-temperature structural and functional applications. These materials can be prepared via high-energy milling of pure metals with Al₂O₃ as well as of aluminum with metal oxides. During subsequent compaction via pressureless sintering, the components react to form dense composites that consist of interpenetrating networks of the ceramic and intermetallic phases. Microstructural investigations, mechanical properties, and resistivity and wear resistance measurements of selected composites are presented. Improved fracture toughness and bending strength, with respect to monolithic Al₂O₃, have been achieved.

[69] MECHANICALLY ACTIVATED REACTIONS OF HALOGEN SUBSTITUTION IN ALKYL HALIDES - IV - MECHANISM OF CHAIN REACTIONS OF RI (R = ME, ET) PROCESSING ON THE SURFACE OF MECHANICALLY ACTIVATED KCl SALTS [Russian]

Mitchenko SA. Zamashchikov VV. Dadali YV. - Zhurnal Organicheskoi Khimii. 34(5):670-674, 1998

[69] ESTIMATES OF THE FORMATION ENTHALPIES OF POINT DEFECTS IN INTERMETALLIC COMPOUNDS WITH THE C15 STRUCTURE AND COMPARISON WITH EXPERIMENTS

Modder IW. Kuin MJ. Bakker H. - Intermetallics. 6(6):537-546, 1998

Miedema's semi-empirical 'macroscopic' atom model, by which estimates of the enthalpy of formation of binary alloys can be calculated, is extended in order to be able to estimate values for the formation enthalpy of anti-site and quadruple-defect disorder in C15 compounds. These values can be used to predict the type of disorder that is created in C15 compounds by heating or ballistic action. Ball milling experiments have been performed on some GdX₂ C15 compounds. The results are reported and compared to the predictions obtained by the model.

[68] FORMATION OF NANOCRYSTALLINE CUBIC (L1(2)) TITANIUM TRIALUMINIDE BY CONTROLLED BALL MILLING

Varin RA. Wexler D. Calka A. Zbroniec L. - Intermetallics. 6(6):547-557, 1998

Pre-alloyed, as-cast ingots of the Mn-modified, cubic (L1(2)) titanium trialuminide (65 at% Al, 25.6 at% Ti and 9.4 at% Mn) were homogenized (1000 degrees C/100), crushed into a coarse-particle powdered material and subsequently ball milled for up to 386 h under shearing mode in a controlled ball movement mill. X-ray spectra of

milled powders showed line broadening and decrease in intensity of Bragg peaks with increasing milling time. This is associated with the formation of nanocrystalline grains and lattice strains upon milling. Crystallite size calculated from peak broadening, remains relatively unchanged from 19 up to 100 h of milling (20-30 nm) and then drastically decreases reaching a saturation size of about 3 nm after 200 h of milling. Lattice strains are on the average less than 1%. Simultaneously, the ordered L1(2) crystal structure undergoes disordering which commences after approximately 40 h and terminates after 160 h of milling. The microstructure of powder particles undergoes a complex evolution. With increasing milling time the particles are formed which appear to contain a work-hardened core. Each such a particle is surrounded by a heavily deformed, hard outer layer containing nanometer grains. After 386 h of milling all the core/outer layer particles are transformed into uniform 'no core' ones, characterized by approximately 3 nm crystallite size (XRD measurements). The microhardness data for both outer layer in the powder particles with a core, and the 'no core' particles can be fitted by a Hall-Petch dependence on the inverse root of crystallite size: $HV_{0.01} = 431.7 + 387.5d^{-0.5}$ (kg mm⁻²) where $HV_{0.01}$ is Vickers microhardness at 0.01 kg and d is crystallite size in nm. These results are discussed in view of the existing models of hardening of nanosized materials.

[67] ELECTROCHEMICAL PROPERTIES OF Mg₂Ni AND Mg₂Ni₂ PREPARED BY MECHANICAL ALLOYING

Lenain C. Aymard L. Tarascon JM. - Journal of Solid State Electrochemistry. 2(5):285-290, 1998

Crystallized Mg₂Ni and Mg₂Ni₂ amorphous alloys synthesized by mechanical alloying at room temperature were found to present first discharge capacities of 270 mAh/g and 500 mAh/g, respectively. These capacities decrease upon subsequent cycling to reach 30 mAh/g and 70 mAh/g after 60 charge/discharge cycles. The largest initial capacity, measured for the Mg₂Ni₂ composition, is ascribed to its amorphous nature, while its poor capacity retention upon cycling appears to originate from a fine Ni dispersion within the Mg/Ni matrix. This dispersion enables a better protection of the Mg against oxidation during cycling. We show, however, that this protection of Mg by Ni is not sufficient to avoid a strong corrosion of Mg in the KOH electrolyte during cycling, leading to the formation of Mg(OH)₂.

[66] STATE-OF-THE-ART AND PERSPECTIVES IN PARTICULATE NANOSTRUCTURED MATERIALS

RA Andrievski - ADVANCED MATERIALS AND PROCESSES (Series: MATERIALS SCIENCE FORUM), 1998, Vol 282-2, pp 1-9

Nanostructured materials (NM) are characterized by a typical structural size below 100 nm. The possibility of realization of some unique physico-mechanical and physico-chemical properties in the nanocrystalline state is attractive for many specialists of material science, physics and chemistry of solid state, and high technology. The understanding of relationship between different properties and structure is so found to be not trivial. Methods of NM preparation particulate and film NM are generalized in this review. A "soft" crystallization from amorphous state and plastic deformation are also considered. Special attention is given to high-energy consolidation methods. Properties of NM are discussed in connection with possible application.

[65] LOCAL STRUCTURE OF BALL-MILLED CARBONS FOR LITHIUM ION BATTERIES: A PAIR DISTRIBUTION FUNCTION ANALYSIS

A Claye, P Zhou, JE Fischer, F Disma, JM Tarascon - MATERIALS FOR ELECTROCHEMICAL ENERGY STORAGE AND CONVERSION II - BATTERIES, CAPACITORS AND FUEL CELLS (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 496, pp 563-568

The local atomic structure of ball-milled carbons was investigated by radial distribution function (RDF) analysis using pulsed time-of-flight neutron diffraction. The results exhibit a gradual loss of long-range order as a function of milling time. Modeling of the elastic structure factors and of the differential correlation functions identified the structure of ball-milled carbons as finite-size graphene fragments whose size decreases continuously with milling time. The large increase in lithium reversible capacity after 20 hours of milling was correlated with the loss of interlayer correlation between graphite flakes, similar to the structure of hard carbons in the "House of Cards" model.

[64] NANOSTRUCTURED MATERIALS PRODUCED BY HIGH-ENERGY MECHANICAL MILLING AND ELECTRODEPOSITION

ML Trudeau - NANOSTRUCTURED MATERIALS (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1998, Vol 50, pp 47-70

The field of nanostructured materials has gained worldwide prominence in recent years as an area with great potential for new technological advances. As the field develops, the need for large quantities of materials with complex nanostructures will become more and more pronounced. Probably one of the most efficient synthesis techniques for obtaining large quantities of these materials is high-energy mechanical milling. One of the goals of this paper is to review some of the concepts related to nanostructure design and processing using the milling process. Some physical considerations will be presented as examples of various nanostructured systems are discussed. The examples will also serve as a basis for examining some technological applications based on mechanically processed nanostructured materials. If mechanical milling is considered as the method of choice for producing large quantities of nanostructured powders, electrodeposition is probably the most efficient synthesis technique to obtain dense, nanostructured end products for a variety of applications. Recent advances in controlling particle nucleation and growth during electrodeposition have resulted in a renewed interest in this processing method. Because of its enormous potential, the second part of the paper is devoted to recent advances in this area.

[63] PROCESSING AND PROPERTIES OF NANOSTRUCTURED MATERIALS PREPARED BY SEVERE PLASTIC DEFORMATION

RZ Valiev, IV Alexandrov, RK Islamgaliev - NANOSTRUCTURED MATERIALS (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1998, Vol 50, pp 121-142

A review of recent works dealing with processing of ultrafine-grained, nanostructured materials by severe plastic deformation and investigation of their properties is given in the present paper. The paper considers details of processing methods, structural features of processed ultrafine-grained materials and discusses their unusual

deformation behavior and properties.

[62] THE PROPERTIES OF FE-NI FCC ALLOYS HAVING A NANOSTRUCTURE PRODUCED BY DEFORMATION, IRRADIATION AND CYCLIC PHASE TRANSFORMATION

VV Sagaradze - NANOSTRUCTURED MATERIALS (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1998, Vol 50, pp 243-262

[61] MAGNETIC STATE, TRANSPORT PROPERTIES AND STRUCTURE OF GRANULAR NANOPHASED SYSTEMS

AY Yermakov, MA Uimin, NV Mushnikov, NK Zajkov, VV Serikov, AY Korobejnikov, NM Kleinerman, AK Shtolz - NANOSTRUCTURED MATERIALS (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1998, Vol 50, pp 425-440

In this paper we report the investigation on the formation, if any, of supersaturated solid solution by mechanical alloying of Cu-20%Co and by hydrogenation of Pr(Co,Cu)₅ intermetallics. A comparative analysis of structure and magnetic properties of above mentioned systems are performed. The structural state of Cu₈₀Co₂₀ system after mechanical alloying and a subsequent thermal treatment has been studied by NMR-spectroscopy and X-ray diffraction. Analysis of the data obtained as well as magnetic and magnetoresistive properties make it possible to assume the formation of ultradispersed cobalt clusters in a copper matrix. A partial dissolving of cobalt in copper is likely to take place in defect regions. Such a structure is responsible for superparamagnetism of Cu₈₀(Co)₂₀ system at T > 150 K and for a considerable giant magnetoresistance (GMR) effect (12% at T = 77 K). A shift of X-ray peaks of a copper matrix can partially be due to a coherence of Cu and Co phases. Quasi-binary Pr(Co_{1-x}Cu_x)₅ intermetallics with 0 less than or equal to x less than or equal to 1 were hydrogenated at elevated temperatures to precipitate Co and Cu and to study their mutual solubility. Low temperature hydrogenation was found to form a CaCu₅-type hydride containing about 1.6 hydrogen atoms per formula unit. Above 500 degrees C the sample decomposed into PrH_{2.6}, Cu and HCP-Co. In the temperature range 330 - 450 degrees C the CaCu₅-type hydride coexisted with the decomposed phases. Structural and magnetic measurements indicated that no solid solution was formed in Co-Cu decomposed phases. The magnetoresistance on both parent and hydrogenated samples did not exceed 0.5 %.

[60] AMORPHIZATION OF ZR-AL UNDER MECHANICAL ALLOYING AT DIFFERENT TEMPERATURES: A RE-ENTRANT MELTING PHENOMENON

HW Sheng, K Lu, E Ma - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 433-438

Zr_{100-x}Al_x powder blends have been subjected to ball milling at different temperatures to investigate the amorphization process. At low temperatures the Zr-Al solid solutions amorphized under the polymorphous constraints, whereas at higher temperatures there was an obvious two-phase coexistence region. The Al concentration for the complete amorphization of Zr-Al increased with increasing temperature, suggesting a re-entrant melting behavior. Both of the temperature- and composition-dependent amorphization mechanisms are analyzed in terms of the thermodynamic properties of the phases involved, as well as the dynamic effects brought in by the non-equilibrium milling process.

[59] NON-EQUILIBRIUM FORMATION OF SILICON NITRIDE DURING BOTH BALL MILLING AND ION BOMBARDMENT

ZL Li, JS Williams, DJ Llewellyn, J WongLeung, M Giersig, DJ Chivers - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 439-443

Phase evolution during ball milling of Si in NH₃ gas and during subsequent annealing has been studied and compared with nitride formation during ion bombardment of Si. X-ray diffraction, differential thermal analysis, Rutherford backscattering and channeling, combustion analysis and transmission electron microscopy have been used as analytical techniques. Results have shown that an amorphous Si₃N₄(Fe) phase forms during milling which transforms into alpha-Si₃N₄ and FeSi₂ on annealing. During ion bombardment, slightly N-rich Si₃N₄ is formed but it is mostly crystalline at temperatures between 150 and 450 degrees C.

[58] POINT DEFECTS AND THE B2 TO FCC TRANSFORMATION IN MILLED FERH

LSJ Peng, GS Collins - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 631-636

Mossbauer measurements were made on FeRh containing 52 atomic percent (at.%) Fe after mechanical milling for different times in a high-energy SPEX 8000 vibrator mill. Hyperfine fields are compared with fields for annealed ferromagnetic (F) samples having the B2 structure in the range 52-58 at.% Fe. For annealed F samples, hyperfine field shifts of -1.66 T and -1.12 T were detected at majority Fe-Fe and minority Fe-Rh probes due to Fe-Rh antisite atoms in, respectively, the first and second atomic shells. Analysis of dipolar fields indicates that the magnetization lies along the <110> direction. The transformation from F B2 phase to a metastable paramagnetic fee phase was observed that was half complete in 8 minutes. Analysis of spectra for the milled F B2 phase show that a second point defect was produced by milling that induces shifts of +6 T and +8.5 T, respectively, at majority and minority probes. Many-spectra fits were made under different defect models that led to the conclusion that milling produces point defects in the triple-defect configuration: 2 Fe-vacancies and 1 Fe-antisite atom. Defect concentrations were determined and show that the fractional concentration of vacancies on the Fe-sublattice increases linearly with milling time, reaching 3 at.% after 8 minutes, a very large value. The rate of transformation from B2 to fee phase appears to be independent of the concentrations of point defects in the B2 phase, indicating that the transformation is purely stress-induced, as in a martensite transformation.

[57] LOW-TEMPERATURE MECHANICAL ALLOYING OF CU-FE AND CU-TA POWDERS

JH He, E Ma - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 637-642

A model analysis is presented which explains ball-milling induced alloying in positive-heat-of-mixing systems in terms of a dynamic balance between externally forced mixing and thermal phase decomposition mediated by deformation-enhanced population of defects. The possibility of eliminating the thermal decomposition to force single phase formation is examined by milling Cu-Fe and Cu-Ta powder mixtures at the liquid nitrogen temperature (LN2T). Over a range of compositions for Cu-Fe and almost the entire composition range for Cu-Ta, the two-phase region observed for room-temperature (RT) milling persisted after cryomilling. The moderate temperature dependence of milling-induced alloying is interpreted by analyzing the dynamics of the generation and annihilation of the nonequilibrium vacancies during deformation and impacts in a SPEX mill.

[56] PHASE EVOLUTION DURING BALL MILLING OF AL IN NH3 AND SUBSEQUENT ANNEALING

JI Nikolov, JS Williams, DJ Llewellyn, A Calka - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 649-654

Phase evolution during ball milling of Al in both N₂ and NH₃ gas has been compared and the annealing behaviour studied in some detail. X-ray diffraction, differential thermal analysis, combustion analysis and scanning and transmission electron microscopy have been used as analytical techniques. Results have shown that a nitride is not formed in N₂ but that Al forms into many small, hollow spheres during milling. In contrast, milling in NH₃ results in an amorphous Al_xNy(O) phase which transforms into crystalline AlN and Al₂O₃ on annealing to 1000 degrees C.

[55] PHASES DRIVEN FAR FROM EQUILIBRIUM BY APPLYING MECHANICAL ENERGY: PHASE TRANSFORMATIONS TO GAMMA-PBSNF4 UPON BALL MILLING

G Denes, D LeRoux, C Madamba - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 667-672

The technique of ball milling has been applied to various phases of superionic PbSnF₄, namely on (i): highly stressed tetragonal alpha-PbSnF₄(aq1) obtained by precipitation from aqueous solutions, (ii): highly stressed tetragonal alpha-PbSnF₄(aq2) obtained by reaction of a solid with an aqueous solution, (iii): stressed orthorhombic o-PbSnF₄ obtained by precipitation from aqueous solutions, (iv): non-stressed tetragonal alpha-PbSnF₄(ssr) obtained by direct reaction between SnF₂ and PbF₂ at high temperature, and on (v): non-stressed tetragonal beta-PbSnF₄ obtained by direct reaction between SnF₂ and PbF₂ at high temperature. In all cases, transformation to microcrystalline cubic gamma-PbSnF₄ is observed very rapidly. This is a unique method for stabilizing high temperature gamma-PbSnF₄ at ambient temperature, which cannot be done by conventional methods, such as quenching. The phases obtained are totally disordered, microcrystalline, and have the memory of their origin.

[54] PHASE TRANSITIONS IN LEAD(II) FLUORIDE UPON MILLING

G Denes, MC Madamba - PHASE TRANSFORMATIONS AND SYSTEMS DRIVEN FAR FROM EQUILIBRIUM (Series: MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS), 1998, Vol 481, pp 673-678

PbF₂ is known to exist under two different polymorphic structures. Orthorhombic alpha-PbF₂ is stable at ambient temperature. It has the PbCl₂ structure. Cubic beta-PbF₂ is obtained by heating alpha-PbF₂. It does not transform back to alpha-PbF₂ On cooling, and it seems to be infinitely stable in the metastable state under ambient conditions. Beta-PbF₂ crystallizes in the fluorite (CaF₂) type. Owing to the large number of potential interstitial sites, many F-Frenkel defects can be formed, which make beta-PbF₂ the highest performance fluoride ion conductor among binary fluorides. In this work, both phases of PbF₂ have been ball milled. Milling alpha-PbF₂ results in a partial transformation to microcrystalline beta-PbF₂. The energy required for obtaining the high temperature phase is probably provided in the mechanical form. Milling beta-PbF₂ leads to partial amorphization and formation of alpha-PbF₂. In this case, milling transforms the high temperature polymorph to the low temperature form, by providing the energy required to overcome the activation energy that keeps PbF₂ trapped in the high temperature beta-form after cooling.

[53] SHOCK INDUCED AMORPHIZATION OF MATERIALS

SK Sikka, SC Gupta - SHOCK COMPRESSION OF CONDENSED MATTER - 1997 (Series: AIP CONFERENCE PROCEEDINGS), 1998, Vol 429, pp 145-150

The pressure induced crystalline to amorphous (c --> a) transition is a topic of considerable current interest (see Sharma and Sikka, Frog. In Mat. Sci. 40 (1996), for a review and references there in). Under static pressures about 50 substances have been amorphized. Some of these have also been vitrified using shock waves. Molecular dynamics simulations have also been done. A comparison shows that the differences in the two loading methods viz. Presence of shear, high strain rate, temperature rise and generation of defects in the shocking process produce the usual differences for (c --> a) transition as for any other solid - solid transition. Following facts are now firmly established:(1) (c --> a) transition under shock loading is a solid - solid transition and not a quenched molten phase, (2) it is a metastable state governed by a three - level free energy diagram, and (3) the density increases observed in some cases in shock recovered samples have structural origins. We will also describe our shock wave results on GeO₂ and FePO₄, and molecular dynamics simulations on quartz.

[52] SHOCK WAVE INDUCED PHASE TRANSITIONS FROM THE TRIGONAL PHASE TO THE COEXISTING AMORPHOUS AND ORTHORHOMBIC PHASES IN ALPHA-FEPO4

KD Joshi, N Suresh, G Jyoti, SK Kulshreshtha, SC Gupta, SK Sikka - SHOCK COMPRESSION OF CONDENSED MATTER - 1997 (Series: AIP CONFERENCE PROCEEDINGS), 1998, Vol 429, pp 163-166

The shock induced response of berlinite form of alpha-FePO₄, which has been studied recently under static pressure, has been investigated in order to examine the effect of shear and high temperature on the process of amorphization in this material. The samples were shock loaded up to 8.5 GPa in a gas gun and after recovery were analyzed using x-ray diffraction (XRD) technique. The sample retrieved from 5.2 GPa revealed an irreversible phase transformation of some of the material to an amorphous and a crystalline orthorhombic structure (space group Cmcm), which are co-existing. The XRD pattern of the 8.5 GPa sample on the other hand displayed the presence of only the orthorhombic

phase along with the ambient structure. The absence of the the amorphous phase is attributed to the reverse transformation due to the high residual temperature in the 8.5 GPa sample. Since the Cmc_m phase is equilibrium high pressure phase of such materials, the results could be interpreted on the three level free energy diagram. The comparison of these results with those reported under static pressure is presented.

[51] NANOSTRUCTURE FORMATION BY DYNAMIC DENSIFICATION AND RECRYSTALLIZATION OF AMORPHOUS TI-SI ALLOY

PJ Counihan, A Crawford, NN Thadhani - SHOCK COMPRESSION OF CONDENSED MATTER - 1997 (Series: AIP CONFERENCE PROCEEDINGS), 1998, Vol 429, pp 419-422

Dynamic densification was used to consolidate mechanically amorphized Ti-Si alloy powders, using a 3-capsule, plate-impact, gas-gun loading system at velocities of 300 and 500 m/s. The recovered amorphous compacts were subsequently annealed above the crystallization temperature. A single-phase nano-structured (50-90 nm) Ti₅Si₃ compound was produced, as revealed by TEM and XRD analysis. In this paper, the influence of dynamic densification on the crystallization behavior of amorphous Ti-Si, and the formation of nano-crystals will be discussed.

[50] PREPARATION OF METASTABLE ALLOY BULK MATERIAL IN FE-CU SYSTEM BY MECHANICAL ALLOYING AND SHOCK COMPRESSION

XS Huang, M Ono, T Mashimo - SHOCK COMPRESSION OF CONDENSED MATTER - 1997 (Series: AIP CONFERENCE PROCEEDINGS), 1998, Vol 429, pp 631-633

Metastable alloy bulk body including solid solution in iron (Fe)-copper (Cu) system was prepared by mechanical alloying (MA) and shock compression. The MA-treated Fe-Cu system (50:50 in mol%) powder showed an X-ray diffraction pattern of a single phase of face-centered cubic (FCC) structure. The lattice parameter of FCC structure of the MA-treated powder was larger than the one of pure copper. The X-ray diffraction pattern of the shock-consolidated bulk body did not much change from the one of the MA-treated powder. Instrumental chemical analyses revealed only slight changes in compositions by the MA-treatment and shock-compression.

[49] A WIDE VARIETY OF CARBON BEHAVIOR - AMORPHOUS DIAMOND FABRICATED FROM C-60 FULLERENE BY SHOCK COMPRESSION AND RAPID QUENCHING

H Hirai, K Kondo - SHOCK COMPRESSION OF CONDENSED MATTER - 1997 (Series: AIP CONFERENCE PROCEEDINGS), 1998, Vol 429, pp 675-680

Shock compression can generate extreme conditions such as dynamic high pressure and high temperature, so it is effective technique to understand hidden nature of material and also to explore new advanced materials. Carbon is one of the most attractive and suitable material for such research, because of involving various potentials. This paper gives a brief overview of a wide variety of carbon behavior and a review of recent high pressure studies on C-60 fullerene. As a typical research applying shock compression effectively, our recent works of fabricating amorphous diamond from C-60 fullerene is mentioned. Potentials for developing new advanced materials are also described.

[48] HIGH TEMPERATURE CORROSION OF B2 IRON ALUMINIDES

Mignone A. Frangini S. Labarbera A. Tassa O. - Corrosion Science. 40(8):1331-1347, 1998

The high temperature oxidation of two B2-Fe₄₀Al Iron Aluminides has been studied in isothermal and cyclic conditions in the range 700 degrees C to 1100 degrees C and compared with a FeCrAlY alloy. One of the aluminides was prepared by mechanical alloying with the addition of an Y₂O₃-dispersion that conferred to it improved mechanical properties. No significative differences in the isothermal oxidation of the aluminides have been observed due to the presence of the Y₂O₃. Both aluminides presented higher oxidation rates than the FeCrAlY alloy at 758 degrees and 858 degrees C but lower rates at 1118 degrees C. The tests carried out under thermal cycling (100 1-hour cycles: 40 minutes at 900 degrees C plus 20 minutes at room temperature) showed that the FeCrAlY alloy presented a lower weight increase than both Iron aluminides. Scanning electron microscopy observations revealed a similar acicular morphology of the thin oxide layer formed on the aluminides. The oxide grown on the FeCrAlY alloy presented nodule formation.

[47] THE EFFECTS OF MICROSTRUCTURE ON THE MECHANICAL PROPERTIES OF AL₂O₃-NiAl COMPOSITES

Tuan WH. Chou WB. You HC. Chang ST. - Materials Chemistry & Physics. 56(2):157-162, 1998

In the present study, the room-temperature mechanical properties of Al₂O₃-NiAl composites containing 0 to 100 vol.% NiAl are determined. The composites are prepared by attrition milling Al₂O₃ and NiAl powders together followed by hot-pressing in vacuum. The Al₂O₃ and NiAl grains in the composites constrain each other's growth. Since the hardness of NiAl is lower than that of Al₂O₃, the hardness of the composites decreases with the increase of NiAl content. The strength and toughness of the Al₂O₃-NiAl composites are higher than the values predicted by the rule of mixtures. The strengthening effect is mainly contributed by the microstructural refinement. Because the Al₂O₃/NiAl interface is weak, cracks propagate mainly along the interfaces. The fracture toughness is thus enhanced.

[46] ELECTRODE CHARACTERISTICS OF NANOCRYSTALLINE AB(5) COMPOUNDS PREPARED BY MECHANICAL ALLOYING

Chen Z. Chen Z. Su Y. Lu M. Zhou D. Huang P. - Materials Research Bulletin. 33(10):1449-1455, 1998

Nanocrystalline LaNi₅ and LaNi_{4.5}Si_{0.5} synthesized by mechanical alloying were used as negative materials for Ni-MH batteries. It was found that the electrodes prepared with the nanocrystalline powders had similar discharge capacities, better activation behaviors, and longer cycle lifetimes, compared with the negative electrode prepared with polycrystalline coarse-grained LaNi₅ alloy. The properties of the electrodes prepared with these nanocrystalline materials were attributed to the structural characteristics of the compounds caused by mechanical alloying.

[45] THE MECHANOCHEMICAL REACTIONS BETWEEN CSF AND KAOLINITE

Lapides I. Yariv S. Lahav N. Brodsky I. - Colloid & Polymer Science. 276(7):601-609, 1998

The grinding of a mixture containing kaolinite and CsF was carried out by three different techniques, short manual

grinding, Fisher mechanical mortar and Retsch ball mill. In addition to different cesium aluminium silicates which were detected by X-ray powder diffraction, a new type of intercalation complex was identified by FTIR spectroscopy. The X-ray diffractogram of this complex did not show any basal spacing, which may characterize the complex but the 0.715 nm characteristic peak of the untreated kaolinite became very weak. The Retsch ball mill led to a slight destruction of the kaolinite and the formation of small amounts of the new intercalation complex. The delamination of book-like kaolinite assemblages was observed after the manual and Fisher mortar grindings. In the latter grinding techniques the kaolin-like layers persisted and served as the framework for the intercalation complexes.

[44] HYPERFINE FIELDS AND FE MAGNETIC MOMENTS IN FE-RH ALLOYS - A MOSSBAUER SPECTROSCOPY STUDY

Filoti G. Kuncsea V. Navarro E. Hernando A. Rosenberg M. - Journal of Alloys & Compounds. 278(1-2):60-68, 1998

The Mossbauer spectra of the melt-spun and subsequently intensively ball-milled Fe₆₅Rh₃₅, Fe₅₀Rh₅₀ and Fe₂₆Rh₇₄ alloys with fcc structure are characterized at 4.2 K by broad hyperfine field distributions. The magnetic critical temperatures are 60(5) for the first one and, respectively, 85(5) K for the second and the latter composition, in good agreement with recent magnetic susceptibility studies. The distributions arise as result of the chemical disorder, local strains and atomic displacements, owing to the drastic ball-milling process. The values of the Fe magnetic moments at the peaks of the hyperfine field distributions reached 1.1, 1.6 and 1.9 μ (B) with decreasing iron concentration in semi-quantitative agreement with earlier experimental and recent theoretical evaluations of Fe moments in gamma-Fe and fcc Fe₅₀Rh₅₀. Above 400 K an irreversible transformation to the bcc structure occurs for the two Fe-rich alloys with three types of Fe sites in the Fe richest alloy and two different Fe sites in the partially disordered Fe₅₀Rh₅₀. Our analysis allowed us to describe the nearest atomic arrangements around these sites.

[43] STRUCTURES, PROPERTIES AND RESPONSES TO HEAT TREATMENT OF CU-Y ALLOYS PREPARED BY MECHANICAL ALLOYING

Tan LK. Li Y. Ng SC. Lu L. - Journal of Alloys & Compounds. 278(1-2):201-208, 1998

Cu_{100-x}Y_x (x=5, 10 and 470 wt. %) alloys were synthesized from elemental powders using mechanical alloying for different durations up to 40 h. The as-milled powder samples were heat treated for 2 h at 300 and 500 degrees C. These samples were characterized by scanning and transmission electron microscopy (SEM and TEM, respectively), X-ray diffractometry, microhardness testing and particle size analysis. Nano-sized alpha Cu grains were found by TEM analysis in all compositions after milling for 20 h by TEM analysis. Both SEM and particle size analyzer confirmed the flattening of the particles into thin discs after milling for 2 h and their size decreased on further milling, reaching a minimum after milling for 10 h and increased significantly after milling for 20 h. No Y or secondary phases were detected by XRD for Cu₉₅Y₅ after milling for 20 h. However, a small amount of Cu₅Y/Cu₄Y was found in the same sample by TEM. The microhardness values increased with milling time, reaching a maximum for powder sample that had been milled for 20 h for Cu₉₅Y₅, and 40 h for Cu₉₀Y₁₀ and Cu₈₀Y₂₀ respectively. Heat treatment at 500 degrees C for 2 h on the Cu₉₅Y₅ powders which had been milled for 20 h produced no significant coarsening of alpha Cu grains as the size of these grains was still in the nanometer region. However, the amount of Cu₅Y/Cu₄Y as detected by TEM was found to increase upon heat treatment.

[42] INVESTIGATIONS OF THE SOLID STATE REACTION PROCESS IN MECHANICALLY ALLOYED ZR-AL-CU-NI BULK METALLIC GLASSES BY ANALYTICAL TRANSMISSION ELECTRON MICROSCOPY

Seidel M. Reibold M. Eckert J. - Fresenius Journal of Analytical Chemistry. 361(6-7):740-742, 1998

Starting with elemental powders, the progress of amorphization in mechanically alloyed Zr₆₅Al_{17.5}Cu_{17.5}Ni₁₀ has been investigated by x-ray diffractometry and transmission electron microscopy (TEM). Detailed investigations of the microstructural evolution during milling indicate that the amorphization proceeds by solid state reaction, similar to other well known binary or multicomponent systems.

[41] THERMOMAGNETIC BEHAVIOR AND FIRST ORDER MAGNETIZATION PROCESSES OF SM₃FE₂₉-XTX AND SM₃FE₂₉-XTXN₄ (T = V AND CR)

Han XF. Wang JL. He TM. Lin Q. Han BS. Yang FM. - Physica Status Solidi A-Applied Research. 168(2):487-493, 1998

A systematic investigation of structure and intrinsic magnetic properties of the compounds Sm₃Fe_{29-x}T_x (T = V and Cr) and their nitrides has been performed. Nitrogenation resulted in remarkable improvements in the saturation magnetization and anisotropy fields at 4.2 K and room temperature. First order magnetization processes are observed at around 5.7 T for Sm₃Fe_{26.7}V_{2.3} and around 2.8 T for Sm₃Fe_{24.0}Cr_{5.0} and Sm₃Fe_{24.0}Cr_{5.0}N₄, respectively. The spin reorientation of the easy magnetization direction of Sm₃Fe_{26.7}V_{2.3} is observed at around 230 K. As a preliminary result, the maximum remanence B_r of 0.94 T, the coercivity μ (0)H(C) of 0.75 T, and the maximum energy product (BH) of 108.5 kJ/m³ for the nitride magnet Sm₃Fe_{26.7}V_{2.3}N₄ are achieved by ball-milling at 293 K.

[40] FINE PURE MULLITE POWDER BY HOMOGENEOUS PRECIPITATION

Sueyoshi SS. Soto CAC. -Journal of the European Ceramic Society. 18(9):1145-1152, 1998

A fine pure mullite powder, was prepared by homogeneous precipitation. A suspension consisting of fumed silica (Aerosil 200(R)) and a mixture of aqueous solutions of aluminium sulphate and ammonium bisulphite, was heated to decompose and eliminate sulphur dioxide. This homogeneous precipitation process produced an amorphous basic aluminium sulphate salt coating the surface of fumed silica. This precursor was transformed principally, into Al-Si spinel immediately after the decomposition of sulphate at 950 degrees C, at the same time, a trace of crystalline mullite has produced. The phase changed according to heating temperatures from 950 degrees to 1350 degrees C for 1h. The single phase of mullite was obtained by calcining the precursor at temperatures higher than 1250 degrees C, and the peak of the XRD and IR were sharpened with increasing temperature. The powder calcined at 1350 degrees C was characterized by XRD, IR, SEM, and Klyachko-Gurvich technique. The final product was an agglomerate

consisted of 100-200nm mullite particles in size, and from which fine pure mullite particles were easily obtained by milling. The specific surface area of mullite powder was 27.5m²(g(-1)). This process for preparing fine mullite powder was very simple and inexpensive.

[39] PREPARATION OF ND-DOPED BaCeO₃ PROTON-CONDUCTING CERAMIC AND ITS ELECTRICAL PROPERTIES IN DIFFERENT ATMOSPHERES

Chen FL. Sorensen OT. Meng GY. Peng DK. - Journal of the European Ceramic Society. 18(10):1389-1395, 1998. Nd-doped BaCeO₃ was prepared by a conventional ceramic processing technique using a special procedure to reduce calcining and sintering temperatures and to avoid possible contamination. BaCe_{0.9}Nd_{0.1}O₃-alpha single perovskite phase was formed when the mixture powders was calcined at T greater than or equal to 1000 degrees C. Ball-milling of the calcined powders could well disperse agglomerates. Sintered at T greater than or equal to 1300 degrees C, specimens with density greater than or equal to 93% of the theoretical and without open porosity could be obtained. Electrical conductivity was measured in different dry atmospheres of Ar, air and O₂ and in moist air. The results showed that in dry Ar, air and O₂, the conductivity values at a given temperature were similar, and the activation energies almost identical, possibly because Nd-doped BaCeO₃ demonstrated predominately oxygen ion conduction in these environments. In moist air, proton conduction might predominate, leading to an increase in conductivity and a decrease in activation energy.

[38] EFFECT OF OXYGEN ON THE STRUCTURAL AND ELECTROCHEMICAL PROPERTIES OF NANOCRYSTALLINE Ti-RU-Fe ALLOY PREPARED BY MECHANICAL ALLOYING

Blouin M. Guay D. Schulz R. - Nanostructured Materials. 10(4):523-541, 1998

The effect of the oxygen content on the structural and electrochemical properties of Ti-Ru-Fe-O alloys prepared by high energy ball milling was studied. The structural evolution of the materials has been analyzed by x-ray powder diffraction. The identification of the various crystalline phases, as well as the crystallite size, has been performed by Rietveld refinement analysis. In a first series of experiments, oxygen was added to pre-formed beta(2)-Ti₂RuFe. It was shown that this causes the beta(2) phase to decompose into Ru, Fe and TiO. In a second series of experiments, various amounts of oxygen were added at the very beginning of the milling process by keeping the Ti:Ru ratio constant at 2:1 and varying the Ru:RuO₂ ratio, it was shown that oxygen is only slightly soluble in the beta(2) phase. X-ray photoelectron spectroscopy reveals that Ti and Fe at the surface of the material are highly oxidized while Ru is in the metallic state. The electrochemical properties of these materials have been tested in typical chlorate electrolysis conditions. The electrocatalytic activity of the cold-pressed powders did not show any marked variation with the oxygen content. This is most probably related to the fact that the surface composition of the material is almost independent of the bulk O content. A reduction of the activation overpotential at 250 mA cm⁻² of 200-250 mV is observed when compared to that of a pure Fe cathode.

[37] FORMATION OF NANOCRYSTALLINE Mg₂Si AND Mg₂Si DISPERSION STRENGTHENED Mg-AL ALLOY BY MECHANICAL ALLOYING

Lu L. Lai MO. Hoe ML. - Nanostructured Materials. 10(4):551-563, 1998

Formation of Mg₂Si via mechanical alloying of elemental Mg and Si powders has been investigated. The formation of Mg₂Si occurs after 10 hours of mechanical alloying. Nanocrystalline structure of Mg₂Si with grain size of 22 nm obtained after 50 hours of milling was found to be stable upon heating to about 390 degrees C. Sudden increase in crystalline size to 157 nm after annealing at 520 degrees C was observed. Although the reaction between Mg and Si could be completed after about 50 hours of mechanical alloying, thermal assisted reaction starting at as low as 190 degrees C could promote the formation of Mg₂Si at a short milling duration and hence, reduce Fe contamination. Mg-Al alloy reinforced by Mg₂Si was prepared by milling Mg, Si and Al powders. Intermediate phase of Al₁₂Mg₁₇ has been detected after 5 hours of mechanical alloying. This intermediate phase was observed to disappear to form equilibrium solid solution of Mg-Al alloy after annealing at 300 degrees C.

[36] STRUCTURE AND MAGNETIC PROPERTIES OF ND-FE-B-TI PREPARED BY MECHANICAL ALLOYING

Zhang ZD. Liu W. Sun XK. Zhao XG. Xiao QF. Sui YC. Zhao T. - Journal of Magnetism & Magnetic Materials. 188(1-2):246-247, 1998

[35] INFLUENCE OF HIGH-ENERGY BALL MILLING ON THE PHYSICO-CHEMICAL AND CATALYTIC PROPERTIES OF TITANIUM SILICALITE TS-1

On DT. Kapoor MP. Thibault E. Gallot JE. Lemay G. Kaliaguine S. - Microporous & Mesoporous Materials. 20(1-3):107-118, 1998

The present work aims at examining the structural stability as well as the changes in the state of titanium silicalite upon high-energy ball milling. Various techniques including XRD, BET, UV-visible, FTIR and XPS were used to monitor the physico-chemical properties of TS-1 as a function of milling time. The changes in catalytic activity of TS-1 in n-hexane oxyfunctionalization and l-hexene epoxidation by H₂O₂ with grinding time were also correlated with the corresponding variations in micropore volume, external surface area and BET surface area. The clear differences observed in the catalytic results for the two reactions allow definite conclusions with respect to the nature of the Ti-sites responsible for n-hexane and l-hexene reactions.

[34] HETEROGENEOUS CATALYSTS OF HYDROGENATION [Review] [Russian]

Navalikhina MD. Krylov OV. - Uspekhi Khimii. 67(7):656-687, 1998

The main types of heterogeneous catalysts used for hydrogenation, the methods for their preparation, structure and chemistry of their surface are considered, as well as catalytic activity and the mechanism of action in the hydrogenation of unsaturated and aromatic compounds, CO, carbonyl compounds and in hydrorefinement of fuels. The primary attention is paid to supported Ni catalysts, the methods for their preparation, physico-chemical studies and the development of novel catalytic systems via modification. A novel type of catalysts for hydrogenation, metal carbides, is described. Some aspects of mechanochemical treatment of hydrogenation catalysts, including in situ methods, are discussed. Sulfide catalysts of hydrorefinement are also described in detail.

[33] SYNTHESIS OF A NANOCRYSTALLINE W-25 WT.PERCENT RE ALLOY BY MECHANICAL ALLOYING

Ivanov EY. Suryanarayana C. Bryskin BD. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 251(1-2):255-261, 1998

The formation of a nanocrystalline tungsten-rhenium solid solution by mechanical alloying in a SPEX mill using tungsten carbide vial and balls was investigated. The milling process was monitored by X-ray diffraction and electron microscopy techniques. It was shown that mechanical alloying of a W-25 wt.% Re powder mixture resulted in the formation of a W-Re solid solution with a very small volume fraction of the α phase. The grain size of the solid solution phase is in the nanometer range. Sintering of the mechanically alloyed powder resulted in a dense and high-purity product.

[32] HARDNESS AND TOUGHNESS OF MOSI₂ AND MOSI₂-SiC COMPOSITE PREPARED BY REACTIVE SINTERING OF POWDERS

Morris DG. Leboeuf M. Morris MA. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 251(1-2):262-268, 1998

Samples of monolithic MoSi₂ and a MoSi₂-SiC composite have been prepared by milling elemental powders followed by reactive hot pressing to dense materials with line microstructures. Mechanical properties (hardness and toughness) have been deduced from hardness imprints and related to the scale of the microstructure. Toughness is increased somewhat in the monolithic intermetallic at fine grain size as well as by the addition of the SiC second phase. Cracking begins always by intergranular decohesion, which seems little affected by the grain size or the presence of the second phase, and subsequently becomes transgranular in MoSi₂ and mixed transgranular-intergranular in the MoSi₂-SiC composite. The propagation of such longer cracks depends on the microstructure, with both finer matrix grain size and the presence of SiC leading to more difficult crack growth.

[31] CHARACTERIZATIONS OF MECHANICALLY ALLOYED TI-ZR-CU-NI POWDERS

Liu XD. Nagumo M. Umamoto M. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 252(2):179-187, 1998

Influences of Zr and Ti contents on amorphization of Ti-Zr-Cu-Ni alloy induced by mechanical alloying are studied. It is found that by increasing Zr content, the 100 h-milled Cu_{58-x}Zr_xTi₃₄Ni₈ (at %) alloys change from a single fcc solid solution ($x = 0$) to a partially amorphous state ($x = 11$) and finally to almost a single amorphous phase (x greater than or equal to 31). By changing Ti content, partial amorphization is confirmed to occur in the Cu₄₇Zr₁₁Ni_{42-x}Ti_x (at.%) alloy with x greater than or equal to 22. Influences of Zr and Ti contents on the thermal stability of the as-milled Cu_{58-x}Zr_xTi₃₄Ni₈ and Cu₄₇Zr₁₁Ni_{42-x}Ti_x alloys are investigated by means of a differential scanning calorimeter and X-ray diffraction. Oxidation of zirconium in the above as-milled alloys upon heating is discussed.

[30] ENHANCED MECHANICAL PROPERTIES OF AN AL BASED METAL MATRIX COMPOSITE PREPARED USING MECHANICAL ALLOYING

Lu L. Lai MO. Ng CW. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 252(2):203-211, 1998

An Al-4.5wt.%Cu-10vol.%SiCp composite has been prepared using a mechanical alloying technique. The structural evolution of the mechanically alloyed powder mixture was monitored using X-ray diffractometry while its thermal behaviour was determined using differential scanning calorimetry. The results showed that both the 0.2% yield and the ultimate tensile stresses increased with the duration of mechanical alloying. This increase is associated with the homogeneous distribution and refinement of the SiC particulates, the formation of oxides and the decreased grain size. The thermal fatigue behaviour of the composite has also been investigated using thermal cycling between - 15 and 150 degrees C. The tensile tests on the thermal cycled specimens were carried out to study the influence of thermal cycling on the mechanical properties of the material. It was found that although the 0.2% yield and the ultimate tensile stresses had improved, cracks had been observed in the matrix material. These cracks may have led to the final failure of the test specimens.

[29] MECHANICAL ALLOYING FOR THE EFFECTIVE DISPERSION OF SUB-MICRON SiCp REINFORCEMENTS IN AL-LI ALLOY COMPOSITE

Boey FYC. Yuan Z. Khor KA. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 252(2):276-287, 1998

Whilst sufficient incentives such as high specific mechanical properties and ease of processing exist for particulate reinforcements for metal matrix composites, optimal processing of these particulate reinforcements is hindered by the difficulty in obtaining a finely and evenly dispersed sub-micron reinforcement. Whilst it is commonly known that finer sized (<2 μ m) reinforcements produce higher specific mechanical properties, they also encounter significant agglomeration problems at that size range, resulting in poor dispersion and subsequently less than optimal mechanical properties for the composite produced. One recent approach attempted in resolving agglomeration problem is the use of a Mechanical Alloying (MA) method. This paper reports on the use of a mechanical alloying (MA) method to disperse SiC particles with an average particle size of 0.8 μ m in an Al-Li alloy matrix medium, followed by a high deformation process to fully consolidate the composite. The resulting composite mix was then compacted using a Cold Isostatic Press followed by a high deformation consolidation using hot extrusion. By using a homogeneity index (Q) to quantify the dispersion, and subjecting the resulting consolidated composite to various mechanical tests, the effect of the Q value on the resulting mechanical properties has been established, indicating that a low Q value (implying a good reinforcement dispersion) resulted in optimal mechanical properties. The lowest Q values were obtained with 8 h of milling at 200 rpm. The resulting MMC showed improved tensile modulus and strength, but as in larger sized reinforcements, the elongation values obtained were low.

[28] DYNAMIC VISCOELASTIC PROPERTIES AND THERMAL PROPERTIES OF Ni POWDER-EPOXY RESIN COMPOSITES

Nikkeshi S. Kudo M. Masuko T. - Journal of Applied Polymer Science. 69(13):2593-2598, 1998

The composite materials containing metal Ni powder of 5-15 μ m in size were prepared by use of the matrix epoxy

resin of glycidyl amine crosslinked with bis-4-amino-3-methylcyclohexyl methane and 2,4-diamine 3,5-dimethyltoluene. Dynamic viscoelastic properties of the composites at various volume fraction ($\Phi(p)$) of Ni powder have been measured over the temperature range from 30 to 300 degrees C. The peak temperatures in dynamic loss modulus-temperature diagrams of the composite increased with increasing $\Phi(p)$, although the peak position was abruptly shifted to lower temperatures in the range of $\Phi(p)$ more than 0.245. At this high concentration of $\Phi(p)$, agglomeration of the particles occurring in the composite lead to reduction of the interaction between Ni particle and epoxy resin. Parallel studies on the thermal conductivity (λ) of the composites materials showed that the value of λ at $\Phi(p) = 0.245$ increased by approximately 7 times that of the original epoxy resin. The shape of Ni particles also affected the thermal durabilities of the composites; the rough surface of Ni powder yields a higher storage modulus of the composite than that of the materials containing the powder with a smooth surface, which had been brought through a ball-milling process. The finding suggested that the increasing in specific surface area of the powder improved the thermal durability of the composites as well as their mechanical properties.

[27] MAGNETOTRANSPORT AND ANTIFERROMAGNETIC COUPLING IN NANOCOMPOSITES EU-S-CO

Tang J. Oconnor CE. Feng L. - Journal of Alloys & Compounds. 277:606-610, 1998

Nanocomposites (EuS)(x)Co100-x (x = 30, 50 and 70) were prepared by mechanical alloying the powders of EuS and cobalt. X-ray diffraction analysis indicated that the average particle size of EuS was reduced to about 10 nm after 50 h of milling. These EuS nanoparticles were finely mixed with the metallic cobalt. Below the Curie temperature of EuS, its moments tended to couple antiferromagnetically with that of cobalt. This macroscopic ferrimagnetic behavior was best demonstrated in the magnetization versus temperature curve of (EuS)(30)Co-70, where a rapid decrease in the magnetization below about 16 K ($T_C = 16$ K for EuS) was observed in the ball milled samples. Interesting magnetotransport behaviors were observed for (EuS)(70)Co-30. Its magnetoresistance was positive at room temperature and changed to negative (-6.3%) at 100 K. Much larger negative magnetoresistance (similar to -50%) was found at 20 K. These results are discussed in the context of spin fluctuation and possible spin tunneling in the system.

[26] MAGNETIC PROPERTIES OF ZINC-COATED SM-2(Fe0.9CO0.1)(17)N-X POWDERS

Arlot R. Machida K. Derango P. Fruchart D. Adachi G. - Journal of Alloys & Compounds. 277:620-624, 1998

High-performance magnetic powders of the Sm-2(Fe0.9Co0.1)(17)N-2.9 compound were prepared by ball milling in an organic solution containing surface active agent (Aerosol OT). The subsequent zinc-coating process allows the powders to be stabilized against oxidation by O-2 or H2O. The above two steps were optimized by investigating the powder particle size (i.e. milling time) dependence and the influence of zinc content on the treatment efficiency, in order to obtain powerful magnets.

[25] OPTIMIZATION OF MASHS PARAMETERS TO OBTAIN A NANOMETRIC FEAL INTERMETALLIC

F. Bernard, F. Charlot, E. Gaffet, J.C. Niepce - Int. J. Self Propagating High Temp. Synthesis, 7 (2) (1998) 233 - 247

Mechanically activated self - propagating high - temperature synthesis (MASHS) is a new way of preparing iron aluminides. This process involves mainly the combination of two steps : mechanical activation where the Fe - Al powder mixture is milled for a short time, and a self propagating high- temperature synthesis (SHS) reaction, which uses the exothermicity of the reaction Fe + Al. When the reaction is initiated, the front of the combustion which, in a fraction of second, increases to an elevated temperature and propagates along the whole sample, directly convert to a dense, Fe - Al intermetallic with nanoscale grain size. To control this fast reaction, a time resolved study was performed which differentiated the shock power during the milling process and the compaction pressure. When the combustion front propagated through the sample, the time resolved X - ray diffraction (TRXRD) combined with an x - ray beam synchrotron followed in situ the phase transformation and infrared thermography facility.

[24] IMPROVEMENT OF CERAMIC METHOD FOR SYNTHESIZING M-TYPE HEXAFERRITES

Dufour J. Lopezvidriero E. Negro C. Latorre R. Alcalá EM. Lopezmateos F. Formoso A. - Chemical Engineering Communications. 167:227-244, 1998

The aim of this paper is to improve the standard ceramic method for the synthesis of hexaferrites, studying several alternatives to the usual raw materials of iron and barium oxides and new ways of developing the wet-milling. The research has been focused in the two first stages (the so-called red-milling and the presintering or calcination step) of this process, optimizing their variables. They are type of milling-fluid, temperature and time of calcination, heating rate and BaO/Fe2O3 molar ratio. The optimization variable was the coercive field. The use of iron oxides different than alpha-Fe2O3 yields hexaferrites with magnetic properties higher than commercial ones. Thus, these hexaferrites are optimum as permanent magnets and can replace other more expensive magnets.

[23] EFFECT OF MECHANICAL ALLOYING ON THE PROPERTIES OF POWDER METALLURGY COMPOSITES OF THE AL-SiC SYSTEM

Vishnyakov LR. Oniskova NP. Gribkov AN. Romashko IM. - POWDER METALLURGY AND METAL CERAMICS. 36(11-12):599-603, 1997

The process of mechanical alloying used in the powder metallurgy processing of Al-SiC materials was applied to the treatment of a mixture of aluminum and silicon carbide particles in an attritor. Optimal processing led to the formation of composite pellets containing SiC particles uniformly distributed in an aluminum alloy matrix. Subsequent compaction of these mechanically alloyed pellets produced material with ultimate strength 587 MPa, elastic modulus 10.5 GPa, and elongation 2.1%. Comparison of measured with calculated values of the elastic modulus indicated a high degree of matrix continuity in the structure of the mechanically alloyed composite material.

[22] GRINDING TIME FOR CONTROL OF THE SIZE FRACTION OF PRODUCTS IN THE ATTRITION MILLING

Park JK. Jeong Y. Yang JI. Jung MY. - Korean Journal of Chemical Engineering. 15(4):375-380, 1998

Grinding tests for garnet were carried out by using an attrition mill under wet processes. Effects of feed filling ratios and a chemical agent (sodium hexametaphosphate, SHP) were investigated on the grinding time of the garnet. The progeny particles obtained were screened into various particle size intervals, which were 100 mesh over, 100/400 mesh and 400 mesh under. In order to estimate the mass fraction of the particles in a given particle size interval,

mathematical models were derived from the first-order reaction model, then compared to experimental data. It was observed that variation of the feed filling ratio did not show a significant effect on the mass fraction of the product. The chemical agent was, however, effective so that the mass fraction could be controlled by adjusting the content of SHP.

[21] EFFECTS OF DECREASE IN NUMBER OF ACID SITES LOCATED ON THE EXTERNAL SURFACE OF NI-SAPO-34 CRYSTALLINE CATALYST BY THE MECHANOCHEMICAL METHOD

Kang M. Inui T. - *Catalysis Letters*. 53(3-4):171-176, 1998

In order to improve shape selectivity of the methanol to ethylene conversion and mitigate coke formation, the acid sites located on the external surface of Ni-SAPO-34 crystals were neutralized by the intrinsic mechanochemical method. Ni-SAPO-34 crystals were mixed in an agate mortar with basic alkaline or alkaline earth metal oxides supported on microspherical non-porous silica. Their catalytic performances in methanol conversion were enhanced, especially in the case of BaO-modified catalyst. The reason was verified by adopting the cracking of t-butylbenzene, which could not access into the pore channel due to its bulky molecular size. These changes in the reaction performance consistently could be ascribed to the decrease of the acid sites on the external surfaces.

[20] NI-SILICA AND CU-SILICA NANOCOMPOSITES PREPARED BY BALL MILLING

Corrias A. Paschina G. Sirigu P. - *Journal of Non-Crystalline Solids*. 234:358-363, 1998

Nickel-silica nanocomposites with different metal volume fractions have been prepared via solid state exchange reactions which were induced by ball milling nickel oxide and silicon powders and by direct milling mixtures of nickel and amorphous silica. A copper-silica nanocomposite has also been prepared by a solid state exchange reaction. The evolution of the systems during the preparation process has been monitored by X-ray diffraction and transmission electron microscopy. Electrical properties of the final samples are examined as a function of composition and preparation method.

[19] SOME KINETIC FEATURES OF MECHANICAL ALLOYING TRANSFORMATION PROCESSES

Delogu F. Monagheddu M. Mulas G. Schiffrini L. Cocco G. - *Journal of Non-Crystalline Solids*. 234:383-389, 1998

The development of a methodological approach and experimental protocols have permitted the accurate evaluation of some of the key parameters of a ball milling process, such as the impact energy and the number of impacts. Thus, a detailed description of the milling regime in terms of energy transfer to the powders has been possible. On this basis, the crystal to amorphous state reaction of Cu-Ti mixture has been studied for widely differing milling conditions. The analysis of X-ray diffraction data has shown correlations between the parameters of the milling treatment which relate to energy and the structural evolution of the amorphous phase. An attempt has been made to relate the observed kinetic features to a rate law involving microscopic pulse energy and structural factors.

[18] STRUCTURAL CHANGE OF GRAPHITE SUBJECTED TO MECHANICAL MILLING

Fukunaga T. Nagano K. Mizutani U. Wakayama H. Fukushima Y. - *Journal of Non-Crystalline Solids*. 234:416-420, 1998

The synthesis of disordered carbon was attempted by a method of mechanical milling. Hexagonal graphite was employed as a starting material. X-ray diffraction patterns indicate that the hexagonal graphite, composed of layers, was transformed into amorphous-like carbon by mechanical milling. This transformation indicates that milling breaks down the layer structure of graphite. However, the atomic arrangement within 3 Angstrom in the radial distribution function, RDF(r), observed by neutron diffraction indicates no change in environment. On the contrary, the coordination number of the first nearest neighbour gradually decreased with increasing milling time. These results indicate that the mean size of the graphite crystallites becomes smaller on milling and approaches about 30 Angstrom diameter in the c axis direction after 36 h of milling.

[17] STRUCTURAL MODIFICATIONS INDUCED IN WURTZITE-CDSE BY HIGH ENERGY MILLING

Lehmann AG. Bionducci M. Buffa F. - *Journal of Non-Crystalline Solids*. 234:421-426, 1998

The wurtzite-sphalerite dimorphism of CdSe is studied by following the effect of high-energy mechanical grinding on the wurtzite form. X-ray powder diffraction patterns are collected at different grinding times. The main effect is the progressive quenching of those Bragg reflections of wurtzite which are absent in the pattern of the sphalerite. A sphalerite-like pattern, with broadened peaks, results after 72 h grinding. A model is proposed which takes into account two effects: a discontinuous transition from wurtzite-to sphalerite induced by grinding and a continuous transition towards an hexagonal disordered structure, via stacking fault formation, based on the concept of latent patent structure.

[16] THE STRUCTURE OF AMORPHOUS SE-S PREPARED BY MECHANICAL ALLOYING

Fukunaga T. Kajikawa S. Hokari Y. Mizutani U. - *Journal of Non-Crystalline Solids*. 234:465-469, 1998

The structure of trigonal Se consists of chains and that of rhombic S is based on a packing of S₈ ring molecules. The mechanical alloying (MA) of Se-S powders, therefore, leads to a mixture of chains and ring molecules. In the X-ray diffraction pattern, the Bragg peaks associated with trigonal Se and rhombic S gradually disappear and a broad halo becomes dominant with increasing milling time. A longer milling time was required for transforming the crystalline to the amorphous state with increasing S content. Amorphization of the Se-S powders occurred in the range 0-40 at% S. The Se-Se first neighbour distance and coordination number, obtained from neutron diffraction measurements, decrease as the amorphization proceeds. The decrease in the first neighbour coordination number indicates a shortening of the Se chains.

[15] EXAFS STUDIES OF AMORPHOUS FE₅₀TA₅₀ POWDERS DURING MECHANICAL ALLOYING

Lin CK. Lee PY. Yang JL. Tung CY. Cheng NF. Hwu YK. - *Journal of Non-Crystalline Solids*. 234:520-525, 1998

The progress of the preparation of amorphous Fe₅₀Ta₅₀ alloy powders, starting from elemental Fe and Ta crystalline powder mixtures, by mechanical alloying using a SPEX high energy ball mill was investigated. The as-milled Fe₅₀Ta₅₀ powders were examined as a function of milling time by scanning electron microscopy (SEM),

microhardness, X-ray diffraction, differential thermal analysis (DTA), and extended X-ray absorption fine structure (EXAFS). The radial distribution functions (RDFs) obtained from Fourier transformation of EXAFS spectra reveal that there are differences in local atomic structure after prolong milling. When combined with information from other techniques? the results allow the amorphization process for Fe₅₀Ta₅₀ during the mechanical alloying (MA) to be better understood.

[14] A POSITRON ANNIHILATION STUDY OF THE EVOLUTION OF AMORPHIZATION IN Nb₃Sn BY MECHANICAL MILLING

Nasu T. Cho YS. Naslund RA. Jones PL. Greer AL. - Journal of Non-Crystalline Solids. 234:594-599, 1998

In an attempt to probe the effect of vacancy-related defects on the crystalline-to-amorphous phase transformation; positron annihilation lifetime measurements were performed on Nb₃Sn with the A15 structure as a function of mechanical milling. The lifetime spectra were deconvoluted into two components. Both components increased during the initial stage of milling, consistent with an increase in the concentration of the vacancy-type defects and void-type defects formed as a result of milling. The formation of these types of defects plays an important role in the amorphization reaction of A15 Nb₃Sn.

[13] STRUCTURE, CATION DISTRIBUTION, AND PROPERTIES OF NANOCRYSTALLINE TITANOMAGNETITES OBTAINED BY MECHANOSYNTHESIS - COMPARISON WITH SOFT CHEMISTRY

Millot N. Begincolin S. Perriat P. Lecaer G. - Journal of Solid State Chemistry. 139(1):66-78, 1998

Nanocrystalline Fe-based spinels with composition Fe_{2.5}Ti_{0.5}O₄ were synthesized using two different routes: soft chemistry and high-energy ball milling. In the first case, two steps were involved: precipitation in an aqueous solution followed by thermal annealing under a reducing mixture of N₂/H₂/H₂O gases. In the second case, the spinel phase was directly formed in the mill at room temperature and under argon atmosphere from Fe, Fe₂O₃, and TiO₂ in stoichiometric proportions. The as-prepared powders are characterized by X-ray diffraction, scanning and transmission electron microscopy, surface area measurement, and Mossbauer spectrometry. In both cases, the crystallite's size is about 15 nm, but whereas in the case of mechnanosynthesis, the ball-milled powders consist of aggregates, those obtained by soft chemistry are very well dispersed. In contrast to the soft chemistry route, both lattice defects and cation site inversion are induced by high energy ball milling, as evidenced by X-ray diffraction and thermogravimetric analysis. Finally, the particle coercivity is studied and discussed according to particle size and the degree of oxidation of Fe cations inferred from thermogravimetry.

[12] BALL MILLING CONDITIONS OF A VERY SMALL AMOUNT OF LARGE PARTICLES IN SILICON NITRIDE POWDER [Japanese]

Naito M. Hotta T. Hayakawa O. Shinohara N. Uematsu K. - JOURNAL OF THE CERAMIC SOCIETY OF JAPAN. 106(8):811-814, 1998

The effect of ball milling conditions on pulverization of the very small amount of large particles in silicon nitride powder was examined. In this paper, the wet sieve analysis and X-ray sedimentation method were used to measure the content of large particles in the ground powder which influence important properties of sintered ceramics such as fracture strength. As a result, it was made clear that the wet sieve analysis would be a reliable method to measure the content of just a few large particles in the ground powder. By applying this analysis to the ball-mill grinding of silicon nitride powder, it was found that the processing conditions required to grind the large particles were different from those to obtain high specific surface area as well as small average size of particles. This is because the impact force exerted onto the particles by the media balls is more effective on grinding large particles.

[11] IN SITU FORMATION OF TiB₂ REINFORCED ALUMINIUM VIA MECHANICAL ALLOYING

Lu L. Lai MO. Niu XP. Ho HN. - Zeitschrift fur Metallkunde. 89(8):567-572, 1998

This paper investigates the possibility of in-situ formation of TiB₂ ceramic particulates via the process of mechanical alloying of elemental Ti and B powders in a system diluted with Al. Elemental Al powder was mechanically milled together with Ti and B powders in a high energy planetary ball mill. 30 stainless steel balls with diameter of 15 mm were employed. The ball to powder weight ratio was 20:1. X-ray spectra revealed the evolution of structural changes of the alloyed powder particles. No evidence of formation of TiB₂ was manifested when the milling duration was shorter than 30 h. A TiB₂-like structure could be detected only after 40 hour of milling. Because of broadening and weakening of the X-ray diffraction (XRD) peaks corresponding to Al and TiB₂ structures as a result of refinement of crystalline size and the presence of large structural distortion, only very weak and vague TiB₂ XRD peaks could be detected. Clear evidence of formation of TiB₂ was, however, observed when the mechanically alloyed powder was annealed. Therefore, the results of the present investigation clearly indicate that formation of in-situ TiB₂ particulates within Al is possible although a longer milling duration is required. Mechanical testing shows that both the 0.2 % yield and the ultimate tensile stresses are increased with MA duration and sintering duration.

[10] SUPERSATURATED SOLID SOLUTIONS AND METASTABLE PHASES FORMATION THROUGH DIFFERENT STAGES OF MECHANICAL ALLOYING OF FeTi

Novakova AA. Agladze OV. Sveshnikov SV. Tarasov BP. - Nanostructured Materials. 10(3):365-374, 1998

Elemental equiatomic Fe-Ti powder mixture was mechanically alloyed in high energy ball mill. XRD, DTA and Mossbauer spectroscopy (at liquid nitrogen temperature) were utilized to monitor the kinetics as well as the accompanied structural and phase transformations through different stages of milling. Our experiments showed that formation of nanocrystalline FeTi compound proceeds via the formation of the supersaturated solid solutions beta-Ti(Fe) and alpha-Fe(Ti) at the interface. After 36 hours of milling, the main part of powder mixture transformed not only to FeTi but also to Fe₂Ti intermetallic compound. The transition of last part of supersaturated solid solutions beta-Ti(Fe) to those intermetallic phases was observed after annealing of this sample at 600 degrees C.

[9] A COMBINED STUDY OF NANOCRYSTALLINE ALUMINIUM BY X-RAY DIFFRACTION AND MECHANICAL SPECTROSCOPY

Bonetti E. Pasquini L. Sampaolesi E. - Nanostructured Materials. 10(3):437-448, 1998

Nanocrystalline aluminium was prepared by ball milling in different conditions. The milled powders were

characterized by X-ray diffraction in order to determine accurately the crystal size and the internal strains. Mechanical spectroscopy measurements in the 300-700 K temperature range were performed with a torsion pendulum on consolidated nanocrystalline powders. The anelastic spectrum is characterized by a broad internal friction peak and an exponential background. These data are compared with those obtained on a coarse grained sample and correlated with the information derived from X-ray diffraction analysis.

[8] EFFECTS OF MILLING LIQUID ON THE REACTION-BONDED ALUMINUM OXIDE PROCESS

Watson MJ. Chan HM. Harmer MP. Caram HS. - JOURNAL OF THE AMERICAN CERAMIC SOCIETY. 81(8):2053-2060, 1998

The reaction-bonded aluminum oxide process begins with aluminum, Al₂O₃, and usually ZrO₂ powders that have been attrition-milled in an organic liquid, The attrition-milled powder is then compacted and heat-treated in air to produce polycrystalline, Al₂O₃-based ceramics. Safety considerations have made it desirable for the milling liquid to be changed from acetone to a less-flammable solvent. In this paper, mineral spirits, ethanol, and mineral spirits that contains 2 wt% stearic acid are presented as viable alternatives to acetone, The effects of changing the milling liquid on the reaction process and the properties of the final fired ceramic are investigated.

[7] SOLID-STATE REACTION OF A LEAD TETRAACETATE METAL HALIDE SYSTEM WITH NAPHTHALENE UNDER MECHANICAL ACTIVATION

Nikishin GI. Sokova LL. Makhaev VD. Petrova LA. Ignatenko AV. Kapustina NI. - Russian Chemical Bulletin. 47(7):1353-1355, 1998

A mechanically activated solid-state reaction of halogenation of naphthalene with a Pb(OAc)₄-alkaline or alkaline-earth metal halide system was carried out to yield 1-halonaphthalene as the main reaction product and 1,4-dihalonaphthalene. The solid-state halogenation of naphthalene is more selective than a liquid-phase reaction.

[6] SYNTHESIS OF NiAl-TiC NANOCOMPOSITE BY MECHANICAL ALLOYING ELEMENTAL POWDERS
Zhou LZ. Guo JT. Fan GJ. - MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING. 249(1-2):103-108, 1998

A NiAl-TiC nanocomposite has been synthesized by mechanical alloying from Ni, Al, Ti, and C powders. During milling, an abrupt reaction occurred, resulting in simultaneous formation of NiAl and TiC phases. It is suggested that two separate exothermic explosive reactions, i.e. Ni + Al --> NiAl and Ti + C --> TiC, were involved. However, the reactions were incomplete with the existence of a small amount of elemental powders. Prolonged milling led to a gradual formation of NiAl and TiC as well as grain refinement. The final grain size for TiC was 3.5 times as large as that for NiAl. The formation mechanism of the NiAl-TiC nanocomposite during mechanical alloying was also discussed.

[5] AMORPHOUS B-C-N SEMICONDUCTOR

Yao B. Chen WJ. Liu L. Ding BZ. Su WH. - Journal of Applied Physics. 84(3):1412-1415, 1998

Amorphous BC₂N powders were prepared by mechanical milling with hexagonal boron nitride and graphite as starting materials. A bulk amorphous BC₂N compound was produced by sintering the as-milled amorphous BC₂N powders in a vacuum of 10⁻⁵ Torr at a temperature of 1470 K. The conductivity measurement for the bulk amorphous BC₂N compound showed that it behaves as a semiconductor with band gap energy of 0.11 eV for temperatures ranging from room temperature to 560 K and a semimetal for temperatures between 560 and 740 K. The mechanism of the formation of the amorphous BC₂N powders is discussed.

[4] EXTENDED MILLING OF GRAPHITE AND ACTIVATED CARBON

Welham NJ. Williams JS. - Carbon. 36(9):1309-1315, 1998

Graphite and activated carbon have been ball milled under vacuum for up to 1000 hours. The graphite became amorphous, with no evidence of recrystallisation after heating to 1200 degrees C. There was little change in the structure of the activated carbon. Heating the carbons under argon showed that the two milled samples absorbed substantial gas, over 30% of their mass in some cases. The reactivity of both carbons during combustion increased with milling time, the greatest increase was concomitant with a decrease in graphite crystallinity. After milling for 1000 hours, graphite showed similar combustion characteristics to activated carbon. Although iron was present as a contaminant at appreciable levels, there was no evidence that it had any significant effect on the oxidation of the carbon.

[3] STRUCTURAL AND MAGNETIC PROPERTIES OF BALL MILLED COPPER FERRITE

Goya GF. Rechenberg HR. Jiang JZ. - Journal of Applied Physics. 84(2):1101-1108, 1998

The structural and magnetic evolution in copper ferrite (CuFe₂O₄) caused by high-energy ball milling are investigated by x-ray diffraction, Mossbauer spectroscopy, and magnetization measurements. Initially, the milling process reduces the average grain size of CuFe₂O₄ to about 6 nm and induces cation redistribution between A and B sites. These nanometer-sized particles show superparamagnetic relaxation effects at room temperature. It is found that the magnetization is not saturated even with an applied field of 9 T, possibly as the result of spin canting in the partially inverted CuFe₂O₄. The canted spin configuration is also suggested by the observed reduction in magnetization of particles in the blocked state. Upon increasing the milling time, nanometer-sized CuFe₂O₄ particles decompose, forming alpha-Fe₂O₃ and other phases, causing a further decrease of magnetization. After a milling time of 98 h, alpha-Fe₂O₃ is reduced to Fe₃O₄, and magnetization increases accordingly to the higher saturation magnetization value of magnetite. Three sequential processes during high-energy ball milling are established: (a) the synthesis of partially inverted CuFe₂O₄ particles with a noncollinear spin structure, (b) the decomposition of the starting CuFe₂O₄ onto several related Fe-Cu-O phases, and (c) the reduction of alpha-Fe₂O₃ to Fe₃O₄.

[2] MECHANICAL PROPERTIES AND FRACTURE BEHAVIOR OF SiCw REINFORCED AL-12Ti ALLOY PREPARED BY MECHANICAL ALLOYING TECHNIQUE

Jia DC. Zhou Y. - MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING. 252(1):44-52, 1998

Room and elevated temperature mechanical properties and thermal stability of SiC whisker (SiCw) reinforced Al-

12Ti alloys fabricated by mechanical alloying were investigated. The results show that SiCw/Al-12Ti composites manifest higher room and elevated temperature strength and Young's modulus and specific strength and stiffness with increasing SiCw content, which can be attributed to the combined strengthening from Al₃Ti particles and SiC whiskers. The combined strengthening effect is especially good for lower SiCw content. The thermal stability of the composites at 550 degrees C worsens compared to that of the unreinforced MA Al-12Ti alloy. The in situ crack propagation observation under SEM shows that the fracture behavior of SiCw/Al-12Ti composites substantially differs from that of the MA Al-12Ti alloy, but changes slightly with increasing SiCw content. The strengthening mechanisms of the composites are also discussed.

[1] ELECTRICAL PROPERTIES OF GA AND ZNS DOPED ZNO PREPARED BY MECHANICAL ALLOYING

Cook BA. Harringa JL. Vining CB. - Journal of Applied Physics. 83(11 Part 1):5858-5861, 1998

A series of n-type ZnO alloys doped with Ga and ZnS were prepared by mechanical alloying. Densities of 95% Co 98% of theoretical density were achieved by hot pressing the milled powders at 1000 and 1200 degrees C, respectively. The electrical resistivity and Seebeck coefficient of alloys containing 0.25-3.0 at, % Ga were characterized between 22 and 1000 degrees C, The magnitude of the resistivity and Seebeck coefficient at 22 degrees C ranged from 0.2 m Omega cm and -25 mu V/degrees C for the most heavily doped specimen to 1.1 m Omega cm and -70 mu V/degrees C for the lightly doped material. The alloys exhibit a positive temperature coefficient of resistivity and Seebeck coefficient with a nearly constant slope over the temperature range studied. Thermal diffusivity measurements on a specimen containing 1.0 at. % Ga were performed over the same temperature range. The thermal conductivity appears to follow a T⁻¹ dependence, decreasing from 180 mW/cm degrees C at 22 degrees C to 82 mW/cm degrees C at 1000 degrees C, An estimate of the maximum dimensionless thermoelectric figure of merit, ZT, in this system at 1000 degrees C gives a value of 0.26, a factor of three to four less than current state-of-the-art materials such as Si-Ge, A significant reduction in thermal conductivity would be required to make these alloys competitive with existing thermoelectric power generation materials.

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SMM14
14th International Conference on Soft Magnetic Materials
Balatonf,red, Hungary - 8-10 September, 1999
Antal Lovas, Chairman SMM14 - Lajos K. Varga, Co-Chairman SMM14

First Circular
General information

Venue : The SMM14 Conference will be held in the Balaton Convention Center (Hotel F,red), Balatonf,red, Hungary, September 8 (Wednesday) through September 10 (Friday), 1999.

Aim of the Conference : The Soft Magnetic Materials Conference provides a forum for the presentation of basic advances in the study, characterisation, production and application of soft magnetic materials. It traditionally brings together scientists from universities, research institutions and industry who are in the forefront of their specific fields of activity.

Topics : Contributions in the following topics are expected:

Basic problems, magnetisation processes

Grain-oriented, non-oriented and high-silicon electrical steels

Fe-Ni, Fe-Co, soft ferrites

Amorphous and nanocrystalline alloys

Low dimensional materials: powders, thin films, wires ...

Material and circuit behaviour: analysis and modelling of induction, eddy currents, losses, noise ...

Measurement techniques

Applications: actuators, sensors, power engineering, launching

Very high frequency (GHz) inductive elements

Sessions : The SMM14 Conference will be based on plenary sessions devoted to invited speakers. Short oral presentations and poster sessions for regular contributions will follow.

Exhibition : During the Conference, an exhibition of materials, equipments and services is planned.

Working language : The working language of the Conference is English.

Abstracts

The instructions for the preparation of camera-ready abstracts are given separately.

Abstracts (original + 2 good quality copies) should be sent to the SMM14 Secretary. Authors wishing to receive written confirmation must include a self-addressed card with their abstract when it is submitted. Abstracts submitted by fax will not be accepted.

Electronic submission: by e-mail as an attached file in Microsoft Winword 6.0/7.0 doc format. An abstract template file can be downloaded from the SMM14 website.

Abstracts should reach the conference secretary not later than February 15, 1999:

SMM14 Conference Secretary

c/o Dr. L.K. Varga

Research Institute for Solid State Physics and Optics, Hungarian Academy of Sciences

H-1525 Budapest, P.O.B. 49, Hungary

e-mail: smm14@sunserv.kfki.hu

Proceedings

The proceedings of the Conference will be published as a special issue of the Journal of Magnetism and Magnetic Materials. Detailed instructions for preparation of the manuscripts will be sent to the authors once their paper has been accepted for presentation.

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Registration

The conference registration fee can be expected around 480 USD. Registration forms will appear in the Advance Program (second circular) in May 1999.

Accommodation

Hotel accommodation will be offered in Hotel F₃red and Hotel Marina both located at the Conference site. A hotel registration form is attached. The limited number of rooms available in Hotel F₃red will be allocated to participants on a first-come-first-served basis.

Transportation

Budapest is within easy reach of several airports. The airport Minibus Service can take you directly to the conference site. Direct railways link Budapest to Balatonf₃red (1 and a half hour) several times a day.

Accompanying person program

Various activities (museums, sightseeing tours) will be offered.

Deadlines

Receipt of abstracts	February 15, 1999
Notification of acceptance	March 15, 1999
Submission of manuscripts	June 15, 1999

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- H. Ageorges*
- M. Arigon (1998)

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Roucaire Instruments Scientifiques - 2, Avenue du Pacifique, Les Ulis - BP 78

F91943 Courtaboeuf Cedex

- L. Aymard
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UFR Sciences et Techniques - 9 Avenue Alain Savary - BP400 - F21011 Dijon Cedex

LMCTS ESA 6015 - Fac des Sciences 123 Avenue A. Thomas - F87060 Limoges Cedex

- M.-I. Baraton (1997)
- J.-F. Baumard*
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LSG2M- CNRS- Ecole des Mines - F54042 - Nancy Cedex

LRRS - CNRS UMR 5613 - Equipe "Matériaux à Grains Fins"

Faculté des Sciences de Mirande - BP 138 - F21004 - Dijon Cedex

- Ph. Blanchard (1997)
- J.L. Bobet (1998)
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Saft Recherche - Route de Nozay - F91460 Marcoussis

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- J.-M. Castillo (1997)
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Lab. Métal. Phys.- URA CNRS 131 - Bd 3, Téléport 2 - BP 179 -F86960 - Futuroscope Cedex

- P. Chartier (1997)
- B. Cheng (1997)

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CNRS - Lab de Chimie Métallurgique des Terres Rares - 2 - 8 Rue H. Dunant - F94320 Thiais

- G. Cornella*
- D. Cracco (1998)
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- C. Djega - Mariadassou*
- J. Dodds (1997)
- E. Duverger (1997)
- O. El Kedim (1997)
- J.-P. Eymery (1998)
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Lab. Thermodyn. Mét. - URA CNRS 158 - Univ. Nancy I - B.P. 239-54506-Vandoeuvre Cdx

CNRS UPR 423 "Elab. et Transitions de Phases Hors Equilibre"-IPSé -F90010 - Belfort Cedex

Lab. Central de Recherches - Thomson CSF Domaine de Corbeville - F91404 - Orsay

LSG2M- CNRS- Ecole des Mines - F54042 - Nancy Cedex

Ecole des Mines - St Etienne - France

Lab. Fluorures - UPRES CNRS A 6010 - Fac des Sciences - Av. O. Messiaen - 72985-Le Mans

- D. Fruchart (1998)
- J. - C. Gachon (1998)
- E. Gaffet (1997)
- J.P. Ganne (1997)
- T. Giroto (1998)
- C. Goujon (1998)
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Lab. de Génie des Matériaux - ISITEM - CP3023 - F44087 - Nantes cedex 03

- J- M. Greneche *
- T. Grosdidier (1998)
- D. Guerard (1997)
- P. Guigon (1998)
- B. Guilhot*
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- J. - C. Jumas (1997) **LPMS - CNRS D0407** - Univ. Montpellier II - Sci. et Techn. du Languedoc
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- F.A. Kuhnast (1998) **LCSM - URA CNRS 158 - Univ. H. Poincaré - Nancy I - F54506 Vandoeuvre Cedex**
- Y. Labaye* **Eq. Physique de l'Etat Condensé - Univ. du Maine - Fac Sciences - F72017 - Le Mans Cdx**
- P. Lacorre(1998) **Lab. Fluorures - UPRES CNRS A 6010 - Fac des Sciences - Av. O. Messiaen - 72985-Le Mans Cdx**
- M. Latroche **LCMSTR - CNRS - 1 Place A. Briand - F92195 - Meudon Cedex**
- G. Le Caër (1998) **LSG2M- CNRS- Ecole des Mines - F54042 - Nancy Cedex**
- N. Lecomte (1997) **Ressources en Innovation - 49 Rue Edouard Herriot - F69002 Lyon**
- J.M. Lecomte (2000) **Lab. d'Electrochimie des Matér.** - Univ. de Metz - Ile de Saulcy - F57045 - Metz Cedex
- C. Lemoine (1998) **Lab. Magn. & Appl.** -URA 808 -Univ. Rouen-UFR Sci.& Tech-F76821 - Mt St Aignan Cdx3
- C. Lenain **Lab Réactivité & Chimie des Solides - CNRS Université d' 80039 Amiens - France**
- S. Lenard **Univ. Metz - 57 Metz**
- C Levaillant (1998) **Centre Matériaux - Ecole Mines d'Albi Carmaux - Rue de la Poudrière-F81013 - Albi Cedex 09**
- N. Lorrain (1998) **CEN Saclay - DTA / CEREM / DECM / SRMP - F91191 - Gif/Yvette Cdx**
- B. Malaman (1998) **Labo de Chimie Minérale - Univ. de Nancy I - B.P. 239 - F54406 - Vandoeuvre Cedex**
- C. Massobrio (1997) **IPCMS - Groupe Etude Matériaux Métal.** - 23 Rue du Loess - F67037 - Strasbourg Cedex
- C. Meunier (1998) **LMIT - Portes du Jura - F25000 Montbéliard**
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- C. Monty (1998) **IMP - CNRS - BP5 - Odeillo - F66125 Font Romeu Cedex**
- F. Nardou (1997) **LMCTS- Eq. "Céramiques Nouvelles" - 123 Avenue Albert Thomas - F87060 - Limoges Cedex**
- M. Nathl (1998) **ICMCB - Bordeaux**
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- R. Retoux (1998) **Lab. Fluorures - UPRES CNRS A 6010 - Fac des Sciences - Av. O. Messiaen - 72985-Le Mans Cdx**
- S. Revol (1998) **CENG- CEREM - 17 Rue des Martyrs - F38054 - Grenoble Cedex 9**
- S. Rimlinger (1997) **CERMEP - 54 Avenue Rhin et Danube - B.P. 62 - 38041 Grenoble Cedex 9**
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- M. Sarfati (1997) **ETCA - 16 bis avenue du Prieur de la Cote d'Or - F94114 Arcueil Cedex**
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- N. Spath (1997) **Comptoir Lyon - Alemand - Louyot- CR - 8, Rue Portefoin - F75003 - Paris**
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- I. Tkatchenko (1997) **CNRS/ Institut Recherche Catalyse - 2 Avenue A. Einstein -F69626 Villeurbanne Cedex**
- A. Venot (1997) **SINTERTECH - Centre R & D- Voie des Collines - F38800 Le Pont de Claix - France**
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