

RESEAU FRANCAIS DE MECANOSYNTHESE

Lettre N°70

Janvier 2001

**181 Groupes de Recherche
(dont 108 à l'étranger / 32 Pays)**

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

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S.H. Hong - Dpt Materials Science and Engineering - KAIST - Korea
E. Ivanov - Tosoh - USA
M. Senna - Faculty of Science and Technology - Japan
L. Takacs - Dpt Physics - Univ. Maryland - USA

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Le site web du RFM est :

<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.

Bulletin d'adhésion 2001 / Subscription Print

(à retourner à l'adresse suivante - to be sent at the following address) :

Eric GAFFET

UMR5060 – Métallurgies et Cultures

Groupe "Nanomatériaux : Elaboration et Transitions de Phases Hors Equilibre"

Université de Technologie de Belfort – Montbeliard - Site de Sévenans

F90010 - Belfort Cedex - France

Nom/Name :Prénom / First Name :

Adresse complète / Full Address :
.....
.....

Téléphone/ Phone:Télécopie (Fax) :

e_Mel. / e-Mail :

désire adhérer au Réseau Français de Mécanosynthèse /want to be a member of the French Mechanical Alloying Network

Chèque ci joint / Check enclosed in the amount of 100FF

The check has to be to the order : Réseau Français de Mécanosynthèse

(Please do not use Eurocheck, the taxes do correspond to 40% of the amount of the check).

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Announce de congres et / Ou Ecoles
Congress and School Announcements
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**International Conference on Trends
in Mechanical Alloying Science, Technology and Applications (TMA-2001)**

Janpur, India Feb. 21-23, 2001.
Secretariat of Int. Conf. TMA-2001
Organizer : Dr. P. R. Soni
Department of Metallurgical Engineering,
Malaviya Regional Engineering College
Jaipur-302017, India
Tel : +91-0141-702042
Fax : +91-0141-702954
E-mail : <mailto:psmt@arya.recjai.ernet.in>
Contact Persons : Dr. P. R. Soni - Prof. T. V. Rajan

Particles 2001

24-27 February 2001
Rosen Center Hotel, Orlando, FL
<http://www.nanoparticles.org/>

Journées Annuelles 2001 du GFC

Ecole des Mines de St Etienne
22 / 22 Mars 2001
Thèmes prévus :
Corrosion - Filtration - Tribologie - Capteurs
Contacts : B. Guilhot et F. Thévenot
Ecole Nationale Supérieure des Mines de St Etienne
158 Cours Fauriel
42023 - St Etienne Cedex
E_Mail : <mailto:Thevenot@emse.frou> <mailto:BGuilhot@emse.fr>
Rmq : Propositions de communications avant le 15 Janvier 2001

Science et Technologie des Poudres

Nancy - France
3 - 5 Avril 2001
website : <http://www.inpl-nancy.fr/stpoudres3.html>
e_Mail : <mailto:stpoudres@inpl-nancy.fr>

Australian Workshop on Nanotubes and Fullerenes

Australian National University, Canberra,
Mai 3- 4, 2001

Nouveau

Scope

Fullerenes, nanotubes and related nanomaterials are receiving great interest due to the new properties and to potential application in various fields. A workshop is designed to bring together research scientists and engineers working in various disciplines in the broad area of nanotube and Fullerene -related materials and to provide an opportunity to exchange new ideas and results. Students are encouraged to attend with free registration.

Topics

Thermodynamics and Modeling, Synthesis and Processing, Characterization, Properties and Applications

First announcement and call for paper

Send your abstracts and registration by e- mail attachment to awnf200@ anu. edu. au. Abstract format and

registration form can be found at: <http://rsphysse.anu.edu.au/nanotube/awnf2001/>

For more information please contact Dr Ying Chen, Department of Engineering & Research School of

Physical Science and Engineering, The Australian National University, ACT 0200.

Ph: 61 02 62490380, Fax: 61 02 62798338,

E- mail: <mailto:ying.chen@anu.edu.au>.

Partial list of invited speakers:

Prof. D. Tomanek, MSU, USA Prof. G. Wallace, University of Wollongong

Prof. H. M. Cheng, IMR, CAS, China Dr. L. M. Dai, CSIRO

Prof. M. Wilson, UTS

PM2 TEC2001

2001 International Conference on Powder Metallurgy
& Particulate Materials
13 - 17 Mai 2001 - New Orleans - USA
Contact : MPIF

JRFM'2001

21 et 22 Mai 2001 - Amiens - France
Thème : Influence de la mécanosynthèse sur les propriétés physico - chimiques des matériaux
Contact : Luc.Aymardsc.u-picardie.fr
ou <mailto:Eric.Gaffet@utbm.fr>

7th International Symposium on Agglomeration

29, 30, 31 May 2001
Albi - France
Website : <http://www.univ-inpt.fr/~agglom>
or <http://www.enstimac.fr/>

ISMANAM2001

University of Michigan, Ann Arbor, Michigan, USA
Ann Arbor, Michigan, 24-29 June, 2001
<http://www.ners.engin.umich.edu/ISMANAM2001>

Abstract deadline is March 1st, 2001.

Abstracts of 200-400 words should be submitted by e-mail to

E Mail : <mailto:ISMANAM-2001@umich.edu>

The International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials (**ISMANAM 2001**) will be held at the University of Michigan in Ann Arbor, Michigan, United States during 9-14 June 2001. Topics to be covered include nanostructured materials (e.g., nanocrystals or nanoparticles) as well as amorphous and other metastable materials. Both fundamentals and applications will be addressed. We also expect to involve US scientists who have not participated in ISMANAM before. As you may know, previous ISMANAM were held in Grenoble, Quebec City, Rome, Sitges (Spain), Wollongong (Australia), Dresden and Oxford. Next year's ISMANAM will be the first to be held in the United States.

A preliminary list of invited speakers includes:

P. Bellon (U. of Illinois), T. Benameur (Tunisia), A. Calka (Wollongong, Australia), J. Eckert (Dresden), A. L. Greer (Cambridge, UK), A. Hernando Grande (Madrid), A. Inoue (IMR, Sendai), W. L. Johnson (Caltech), J. H. Perepezko (U. of Wisconsin), R. Schulz (IREQ, Montreal), R. W. Siegel (RPI), R. B. Schwarz (Los Alamos), A. Yermakov (Russ. Academy of Sciences, Ektarinburg)

**COLLOQUE SUR LES INNOVATIONS
DANS LES MATERIAUX FRITTES**

Poitiers-Futuroscope
3-4-5 juillet 2001

consulter le site <http://www.sf2m.asso.fr/> (rubriques sommaires puis conférences)

NOUVEAU	<p>International Conference on the Applications of the Mossbauer Effect Oxford, UK 2-7 September 2001</p> <p>Abstracts are now invited for the above meeting, which is the next in the ICAME conference series. You are asked to submit your abstract via the conference website http://www.iop.org/IOP/Confs/ICAME/ by no later than 1 April 2001.</p> <p>For further information or enquiries please contact the Conference Office at the Institute of Physics, 76 Portland Place, London W1B 1NT, UK. E-mail should be directed to: mailto:rebecca.chapple@iop.org</p>
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NOUVEAU	<p style="text-align: center;">(IPCM 2001)</p> <p>La 7eme conference internationale sur les phenomenes d'interface dans les materiaux composites (IPCM 2001) se tiendra au palais des congres d'Arcachon (40 km de Bordeaux) du 11 au 14 septembre 2001.</p> <p>Les themes suivants y seront abordés : Interfaces dans les Biocomposites et fibres naturelles, Composites à matrice organique, Composites à matrice métallique, Composites à matrice céramique, Nanocomposites, avec un interet particulier sur l'elaboration, les relations micro-macro, la modelisation des mecanismes aux interfaces.</p> <p>Conférenciers (liste provisoire)</p> <p>Prof. J. VINCENT (Université de Reading (G.B)) :</p> <p>Comment la structure des coquillages peut-elle nous aider à concevoir des structures composites modernes ?</p> <p>Prof. D. ROUBY (INSA de Lyon (Fr)) :</p> <p>Approche tribologique des interfaces dans les materiaux composites céramiques</p> <p>Prof. N. CHANDRA (Florida University (USA)) :</p> <p>Les mecanismes de rupture aux interfaces dans les composites e matrice métallique</p> <p>Prof. NOBUO TAKEDA (University of Tokyo (Jp)) :</p> <p>Le cisaillement aux interfaces dans les materiaux polymeriques : passage du micro au macrocomposite.</p> <p>Dr J. DOUIN (ONERA (Fr)) :</p> <p>Comment la connaissance des interfaces fibre/matrice par microscopies peut-elle aider les mecaniciens a concevoir leurs modeles ?</p> <p>http://www.arcachoncongres.com/ipcm2001/</p> <p>La date limite pour envoyer votre resumé est fixee au 31/12/2000.</p>
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NOUVEAU	<p style="text-align: center;">(IWSIS-3)</p> <p style="text-align: center;">October, 7-12, 2001.</p> <p>3rd International Workshop on Surface and Interface Segregation , Island of Porquerolles, French Riviera,</p> <p>This Workshop is devoted to the study of the segregation phenomenon in defects of crystallized solids (surface, grain boundary, interface of interphase...)</p> <p>INFOS : http://www.crmc2.univ-mrs.fr/confs/iwsis</p>
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SOUTENANCES DE THESE

T. Ziller

Etude du Mélange à l'Etat Solide lors de la mécanosynthèse d'alliages Fe - X
(X = Cr, Mn, V, Mo) et Etude de la mise en ordre d'alliages Fe - V élaborés par cette Technique

INPL - Ecole des Mines de Nancy

22 Décembre 2000

Jury : J. Foct (Pdt), E. Gaffet (Rapp.), JF Dinhut (Rapp.), L. Chaffron, O. Isnard, G. Le Caer (Dir.)

Th. Grosdidier

Habilitation à Diriger des Recherches

20 Décembre 2000 à 10h00, salle de conseil de l'ISGMP – Ile du Saulcy

LETAM (UMR 7078), Université de Metz.

Jury : Rapporteurs : Pr. Elisabeth Gautier, Pr Jacques Foct, Pr. Günter Gottstein, Pr. David G. Morris - Examineurs : Pr. Marie-Jeanne Philippe, Pr Panos Tsakirooulos, Pr. Francis Wagner.

Les travaux présentés constituent une synthèse d'activités de recherches qui s'intègre dans le cadre de l'opération « Etudes microstructurales et relations texture / microstructure / propriétés ». Les premiers travaux présentés concernent l'étude des mécanismes de déformation qui conditionnent l'aptitude à être mis en forme et les propriétés d'un alliage de titane métastable. Les autres travaux traitent de la formation des textures et microstructures dans des matériaux à grains fins

sur des alliages à base d'aluminium renforcés par des intermétalliques.

Ces travaux se poursuivent, maintenant, dans un cadre plus large, sur des intermétalliques (FeAl) ainsi que sur des matériaux

V. Gauthier

3.

18 Décembre 2000

Jury :

A. C. Sekkal

ou TTS induites par impacts à énergie contrôlée

Ecole Centrale de Lyon

Jury : Esnouf Claude (Pdt) - Gaffet Eric (rapp.) - Georges Jean Marie (Rapp.) - Inglebert Geneviève Langlade-Bomba

N. LORRAIN

30 Octobre 2000 - Université de Grenoble I

Jury :

J.Ph. BRAGANTI

- étude de la cinétique de cristallisation par calorimétrie,

20 octobre 2000 – Université Henri Poincaré – Nancy I – Vandoeuvre lès Nancy

Jury : C. Bergman (Rapp.), J.P. Bros (Rapp.), J.M. Moreau, S. Colin-Bégin, J.C. Gachon, F.A. Kuhnast (Dir)

Le broyage énergétique appliqué à :
l'obtention de mélanges composites à base de magnésium utilisables pour le stockage de l'hydrogène,

16 Octobre 2000 - Université de Bordeaux I - Bordeaux

Jury :

Ch. Gras

Réactivité et Thermodynamique dans le procédé MASHS
(Mechanically Activated Self - Propagating High - Temperature Synthesis) :
Application aux systèmes Mo / Si et Fe / Si
6 Septembre 2000 - Univ. de Bourgogne - Dijon

Jury : Y. Bienvenu (Rapp.), G. Le Caer (Rapp.), G. Bertrand, JP Bonnet, M. Gailhanou, JP Larpin,
F. Bernard (Co - directeur) & E. Gaffet (Co - Directeur)

M. Zouggar

"Effets du broyage sur les propriétés structurales et mécaniques de poudres de fer pur et sur l'activation de la nitruration"

4 Septembre 2000 - LMP - Poitiers

Jury : A. Fnidiki(Rapp.), E. Gaffet (Rapp), P. Goudeau (Inv.), M. Grosbras (Inv.), A. Straboni ,
P. Chartier (Co - Dir) & J. Mimault (Co - Dir)

C. Goujon

"Elaboration par cryobroyage et métallurgie des poudres de nanocomposites à matrice d'alliage d'aluminium renforcée par des particules de nitrure d'aluminium"

25 Mai 2000 - ENSMSE

Jury : P. Goeuriot (Dir. Thèse), G. Le Caer (Rapp.), D. Michel (Rapp.), F. Bernard, Y. Laurent, M. Suery,
F. Thévenot, S. Vicens

J. Joardar

"Synthesis of nanocrystalline aluminides in Al - Ni - Fe system
by Mechanical Alloying"

Avril 2000

Thesis Supervisor : B.S. Murty et S.K. Pabi (IIT, Kharagpur)

Thesis Examiners : C.C Koch (North Carolina State University) , P. Ramakrishnan (IIT, Bombay)

Christine Barbeau

(Laboratoire de Métallurgie Physique - Futuroscope)

Structure dans les matériaux élaborés sous HIP : cas des alliages à base tungstène par frittage et du carbure de titane par combustion auto-propagée

13 mars 2000

Thèse de Doctorat de l'Université de Poitiers

Jury: A. TRAVERSE,(Rapporteur) - F. NARDOU (Rapporteur), D. VREL, M.F. BEAUFORT, M. GROSBAS, J. MIMAUT(Directeur de Thèse)

Hugues GUÉRAULT

PROPRIÉTÉS STRUCTURALES ET MAGNÉTIQUES DE POUDRES DE FLUORURES NANOSTRUCTURÉES MF3
(M=Fe, Ga)

OBTENUES PAR BROUAGE MÉCANIQUE

28 Janvier 2000

THÈSE DE DOCTORAT - Université du Maine - Physique des Matériaux et des Surfaces

Jury : Gérard Le CAER,(Rapporteur), Marc NOGUES, (Rapporteur), Jean-François BÉRAR, Frédéric BERNARD, , Jean-Yves BUZARÉ, , Marc LEBLANC, Jean-Marc GRENÈCHE (Directeur de thèse)

Cyril Lenain

APPLICATION DE LA MECANOCHIMIE A LA PREPARATION D'ALLIAGES HYDRURABLES NANOCRISTALLINS
AB5, MG-NI, AB2 (M) ET DE COMPOSITES M-C, M-Cu : ETUDE DE LEURS PROPRIETES ELECTROCHIMIQUES.

THESE DE DOCTORAT - Specialite: sciences des matriaux presentee a l'Universite de Picardie Jules Verne

Jury : J. Etourneau, M. D. Fruchart, A. Percheron - Guegan, L. Schlapbach, J-M. Tarascon, M. L. Aymard

Cooperative Research on Related Areas

COREE du SUD (19/01/2000)

From Professor Soon H. Hong
Dept. of Materials Science and Engineering - Korea Advanced Institute of Science and Technology
373-1 Kusung-dong, Yusung-gu - Taejon, 305-701, Korea
E-mail : shhong@sorak.kaist.ac.kr / shhong@sorak.kaist.ac.kr
Fax. : 82-42-869-3310 - Tel. : 82-42-869-3327

We are currently working on the mechanical alloying processes and the characterization of mechanical & thermal properties of nanocrystalline materials and composite materials, such as SiC/Al, WC/Co and W/Cu for structural or thermal management applications. We are very pleased to discuss for international cooperative research on related topics with Members of Mechanosynthese Group.

**Job Vacancies, Ph D Position and Post Doc Position
Requests - Proposals**

ALLEMAGNE (11/2000) Ph D or Post Doc Position

We are looking for a PhD candidate / Postdoc to start as soon as possible in the framework of an European RTN network on bulk metallic glasses and nanostructured materials.

Dr. Jürgen Eckert
IFW Dresden - Institut für Metallische Werkstoffe
Postfach 27 00 16 - D-01171 Dresden -Germany
>Tel.: +49 (351) 4659-602/-324
>Fax: +49 (351) 4659-541
>E-mail: <mailto:j.eckert@ifw-dresden.de>

Espagne (25/09/2000) POSTDOCTORAL POSITION (From M.D. Baro)

Universitat Autònoma de Barcelona
The Group de Física de Materials II of the Physics Department of the UAB announces the availability of a 18 months full-time Postdoctoral Research position. Applicants should hold a PhD degree in Materials Science, Physics or in a related field. The position requires:

Knowledge of glasses, metastable and nanocrystalline materials.
Fundamental understanding of the nucleation and crystal growth theories.
Knowledge of calorimetry and thermostability.
Experience in electron, optical and x-ray based characterisation techniques and practices.
Computer literacy.
Citizenship of EU (except Spain) or Associated states.
Under 35 years old.

Proficient level of English

The position begins with effect from January 2001. The research programme includes a close co-operation with other partners of the Project. Applicants should submit a CV, and a statement describing your interest in the position with two references to:

Professor M.D. Baro,
Dept. Physics, Edifici Cc,
08193 Bellaterra,
Barcelona, Spain;
Tel: 34 93 5811657.

Electronic applications can be sent to <mailto:dolors.baro@uab.es>"

Angleterre (21/09/2000) - From Paul Warren (paul.warren@materials.oxford.ac.uk)

Job vacancies in a Research Training Network.
Research Training Network on Manufacture and Characterisation of Nanostructured Al alloys
Pre-doctoral/post-doctoral researchers required at 9 institutions across Europe.

The research positions will involve aspects of : materials processing by gas atomization, rapid solidification and mechanical alloying, followed by compaction; microstructural and microchemical characterisation by XRD, DSC, TEM, STEM, APFIM ; thermodynamic / kinetic modelling and molecular dynamic simulation ; mechanical property evaluation by tensile testing, fatigue testing and high strain rate impact testing.

See Network Homepage <http://www.materials.ox.ac.uk/nano-al/> for more details.

USA (8 / 02 / 2000)

Rutgers University is seeking a postdoctoral associate with demonstrated expertise in powder synthesis and processing (forming and sintering methods) to work on research focused on textured ceramic ferroelectric materials. The candidate must be able to work as part of a multidisciplinary team involving industry and academia focused on making transducer and actuator materials. The candidate should demonstrate the ability to work independently, publish in archival journals and present their work in a public forum. The candidate should send a curriculum vitae, three representative publications (preferably with the candidate as a first author) and the names, addresses, email and phone numbers of three references that can comment on the candidate's capabilities. The position is available immediately at a salary of \$32,000 with health benefits included. The position is available immediately. Placement is preferred prior to August with priority given to a qualified candidate with earlier availability.

Interested candidates should send correspondence to: Professor Richard E. Riman, Rutgers University, Department of

Ceramic and Materials Engineering, 607 Taylor Road, Piscataway, NJ 08854-8065, <mailto:riman@alumina.rutgers.edu>/
732-445-4946 / 732-445-6264

COREE du SUD (10 / 01 / 2000)

From Professor Soon H. Hong

Dept. of Materials Science and Engineering - Korea Advanced Institute of Science and Technology

373-1 Kusung-dong, Yusung-gu - Taejon, 305-701, Korea

E-mail : <mailto:shhong@sorak.kaist.ac.kr>/<mailto:shhong@sorak.kaist.ac.kr>

Fax. : 82-42-869-3310 - Tel. : 82-42-869-3327

The Composite Materials Laboratory at Korea Advanced Institute of Science and Technology is looking for a postdoctoral position. The postdoctoral contract will be one year on the field of modeling and simulation of mechanical & thermal properties of composite materials or on the field of fabrication process of nano-composite materials. Applicant should be within three years of receipt of Ph.D. degree on related field. For more information, please contact :

Bibliographie Récente

Livres ou "Special Issues"

(11/2000) Information from Fritsch (A. Kohler)

The subject of the sixth forum part Fritsch Forum Part VI scheduled for September 14/15th, 2000, will be "high-energy fine grinding". Research and Development demand general-purpose grinding processes which simultaneously exactly define the required energy and the type of stress. This is the only way that reliable results can be achieved when determining activation energies or the mechanical alloying. It must be possible to reproducibly adjust all of the grinding parameters affecting the grinding results.

Participants from research, development and industry will report on demands and novel technological solutions in developing innovative milling technologies. One of the highlights of the event will be FRITSCH's new Vario-planetary mill "pulverisette 4". This planetary ball mill can simulate ball mills of conventional construction, precisely copy the types of stresses that occur there, and thus reproduce or optimise grinding processes. Due to the great flexibility when selecting the grinding parameters, it is possible to produce results that are unattainable with other ball mills. It is the ideal mill for mechanical activation and alloying. The main applications are in the area of material research and naturally wherever a powerful, innovative laboratory planetary mill is needed.

An extensive report has been written about this event which details and makes readily available the relevant parts of the lectures and the extensive results of the discussions. Anyone interested can request a copy of the complete report for this forum part VI event on the topic "high-energy fine grinding". Please contact Andrea Köhler, FRITSCH GMBH, Industriestrasse 8, D-55743 Idar-Oberstein, (Phone: 0049/6784/7046, E-Mail: koehler@fritsch.de)

(7/07/2000) - From Victor Riecanaky Publisher

Cambridge International Science Publishing <http://www.demon.co.uk/cambsci/homepage.htm>

MACROMOLECULAR MECHANOCHEMISTRY

Volume 1: Polymer Mechanochemistry - by Cleopatra Vasiliu OPREA & Florin DAN

Department of Macromolecules, Gh. Asachi, Technical University, 6600 Iasi, Romania

Macromolecular Mechanochemistry presents from theoretical and experimental point of view the main problems of this field, including the results obtained in more than a century of research. It is organised in two volumes: Polymer Mechanochemistry and Polymers with Chemomechanical Functions, respectively. The present volume deals with: Chained Polystage Character of Mechanochemical Process (1), Mechanochemistry of Polymers Deformation (2); Mechanochemistry of Polymer Fracture (including also the Fracture of Composite Materials) (3), and Mechanochemical Processes for Energy Conversion (4). In this frame, the theoretical and experimental material is organised in correlation to the reaction mechanism, the type of mechanical solicitation, and the nature of environmental medium. This book is addressed to professors, students, and researchers involved in the field of polymer science, to engineers from the industry of synthesis and processing of plastic materials, elastomers and fibres, as well as to specialists from all technical domains that exploit polymer-based materials. They will find in the book examination of the theoretical, experimental and applied problems and wide access to the basic literature in this field. Contents

1. Chained polystage mechanism of mechanochemical processes
2. Mechanochemistry of polymers deformation
3. Mechanochemistry of Polymer Fracture
4. Mechanochemical Processes for Energy Conversion

Volume 1 (ISBN 189832672X) will be published in September 2000, approx. 500 pages, cased, approximate price £80.00; (volume 2 will be published at the end of - 2000)

Send your preliminary order to <mailto:orders@cisp.demon.co.uk>

(9/06/2000)

"Mechanical Alloying : FABRICATION OF ADVANCED MATERIALS AT ROOM TEMPERATURE" by M. Sherif El-Eskandarany

(ISBN: 977-299-089-7) Published by DAR AL-FIKR AL-ARABI, Cairo-Egypt.

The price of the book is \$50, and a special discount (20%) is offered to all the RFM member.

Preface

Mechanical alloying (MA) process using ball-milling and/or rod-milling techniques, has received much attention as a powerful tool for fabrication of several advanced materials, including equilibrium, nonequilibrium (e.g., amorphous, quasicrystals, nanocrystalline, etc.), and composite materials. In addition, it has been employed for reducing some metallic oxides by milling the oxide powders with metallic reducing agents at room temperature. The MA is unique process in that a solid state reaction takes place between the fresh powder surfaces of the reactant materials at room temperature. Consequently, it can be used to produce alloys and compounds that are difficult or impossible to be obtained by the conventional melting and casting techniques.

This book intended primarily to serve as an introduction to the MA process, including general description of the process, starting material requirements, the equipment, characterizations of the milled powders, and consolidation techniques, which used to compact the powder into fully-dense bulk materials.

The book contains several typical examples of selected advanced materials that have been fabricated by MA. This book is aimed at either senior undergraduate/post graduate students or materials scientists/metallurgists. - M. Sherif El-Eskandarany - April 2000 - Cairo - Egypt

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Introduction - Background - History of Mechanical Alloying - Milling - Factors Affecting the Mechanical Alloying 8 - Types of Mills 8 - High Energy Ball mill 9 - Attritor Ball Mill 9 - Planetary Ball Mill 11 - Vibratory Ball Mill 12 - Low Energy Ball Mill 15 - Tumbler Ball Mill 15 - Tumbler Rod Mill 16 - Effect of Ball-to-Powder Weight Ratio 19 -

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Systems and Applications - Amorphous Austenitic Stainless Steel 254 - Fabrication of amorphous Fe₅₂Nb₄₈ Special Steel 257 - Fe-Zr-B 259 - Difference between Mechanical Alloying and Mechanical Disordering in the Amorphization Reaction of Al₅₀Ta₅₀ in a Rod Mill - Mechanically Induced Cyclic Crystalline-Amorphous Transformations During Mechanical Alloying - References 295 -

(05/05/2000)

Extractive Metallurgy of Activated Minerals

included in series Process Metallurgy, 10

by P. Balaz - Institute of Geotechnics, Slovak Academy of Sciences

ISBN : 0 - 444 - 50206 - 8 / Price USD 144, Euro 124.79)

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Description

Mechanical activation of solids is a part mechanochemistry, the science with a sound theoretical foundation exhibiting a wide range of potential application. Mechanical activation itself is an innovative procedure where an improvement in technological processes can be attained via a combination of new surface area and defects formation in minerals.

Mechanical activation is of exceptional importance in extractive metallurgy and mineral processing and this area forms the topic of this book and is a result of more than twenty years of research and graduate teaching in the field.

In pyrometallurgy, the mechanical activation of minerals makes it possible to reduce their decomposition temperatures or causes such a degree of disordering that the thermal activation may be omitted entirely. The potential mitigation of environmental pollutants is becoming increasingly important in this context.

The lowering of reaction temperatures, the increase of the rate and amount of solubility, preparation of water soluble compounds, the necessity for simpler and less expensive reactors and shorter reaction times are some of the advantages of mechanical activation in hydrometallurgy. The environmental aspects of these processes are particularly attractive.

Several industrial processes are examined and the flowsheets are presented as successful of activation. In these processes, the introduction of a mechanical activation step into the technological cycle significantly modifies the subsequent steps.

The book is designed for researchers, teachers, operators and students in the areas of extractive metallurgy, mineral processing, mineralogy, solid state chemistry and materials science. It will encourage newcomers to the mechanochemistry to do useful research and discover novel applications in this field.

(3/02/2000)

Two new books on mechanical alloying are now available from Cambridge International Science Publishing (infos fournies par Anne Porter - Publishing Manager - Cambridge International Science Publishing

<http://www.demon.co.uk/cambsci/homepage.htm>)

1. MECHANICAL ALLOYING - FUNDAMENTALS AND APPLICATIONS <http://www.demon.co.uk/cambsci/book52.htm>

Contents

Introduction (history, benefits of mechanical alloying); Mechanical alloying (alloying mills, mills in practice, improved mills, the process, parameters);

Variations of mechanical alloying (reaction milling, cryomilling, repeated rolling, double mechanical alloying, repeated forging); Process control agents in mechanical alloying; Mechanical alloying mechanisms (ductile-ductile system, ductile-brittle system, brittle-brittle system, metastable phase formation, amorphisation, nanocrystallization, extension of solid solubility, activation of solid state chemical interaction);

Energy transfer and energy maps;

Consolidation of mechanically alloyed powders (consolidation techniques, thermomechanical treatment); Mechanical properties of mechanically alloyed materials (tensile properties, fracture, creep, stress corrosion cracking susceptibility);

Modelling mechanical alloying (mechanistic models, deformation, coalescence and fragmentation, evolution of particle size, milling time, powder heating, powder cooling, atomistic model, thermodynamic and kinetic model) Joining of mechanically alloyed materials; Rapid solidification and mechanical alloying; Applications (nickel-based superalloys, Al-based materials, supersaturated solutions, magnetic materials, mechanically alloyed powders for spray coatings, superplasticity, tribological materials, composites, amorphous solids, nanocrystalline materials, solid-state chemical reactions, etc). ISBN 1898326568,

160 pages 234 **156 mm, cased**, £45.00, 1999

DISPERSION STRENGTHENED ALUMINIUM PREPARED BY MECHANICAL ALLOYING, by M Besterçi -
<http://www.demon.co.uk/cambsci/book51.htm>

1. Characteristics of dispersion-strengthened systems **2. Mechanical alloying** (kinetics and mechanism of preparation of the Al-C system by mechanical alloying; compaction of powders and heat treatment of compacts;
3. Microstructure and quantitative evaluation of parameters of dispersion-strengthened materials (definition and properties of interparticle distance; experimental possibilities of determination of structural objects; models of heterogeneous structures and their evaluation; simulation of model structures; analysis of the spatial distribution of particles in the Al-Al4C3 material)
4. Static and dynamic mechanical properties (mechanical properties at elevated temperatures; mechanical properties at 20 °C; effect of interface on the mechanical properties; superplastic properties of the system; thermal stability of the system; creep characteristics; creep-fatigue characteristics)
References - ISBN 189832655X, 90 pages, 234 **156 mm, soft laminated cover**, £25.00, 1999

"Mechanical Alloying : Fundamentals and Applications"

Prof. P.R. Soni (1999) - Cambridge International Science Publishing
web site : <http://www.demon.co.uk/cambsci/book52.htm>

"Non Equilibrium Processing of Materials"

R.W. Cahn - Elsevier Science - Volume 2 in the Pergamon Materials Series
A large number of technical papers have been published in reviews, monographs and conference proceedings, but have almost always been devoted to a single processing technique. This book, however, covers all the non equilibrium processing methods and their effects in a single volume.
web site : <http://www.elsevier.nl/locate/isbn/0080426972>

Bulk Amorphous Alloys : Preparation and Fundamental Characteristics

A. Inoue
Materials Science Foundation Vol. 4 - Trans Tech Publications : <http://www.sciencenet.net>
Interest in bulk amorphous alloys has increased rapidly throughout the world and these materials have now gained a position of great importance in basic science and engineering materials technology bulk amorphous alloys based upon the Zr - Al - Ni - Cu, Zr (Ti,Nb) - Al - Ni - Cu and Zr - Ti - Ni - Cu - Be systems have already achieved wide commercial success as components of various technical accessories ranging from sporting goods to optical instruments.
Here is a state of the art reviews on this new group of materials, covering all areas of interest, ranging from the synthesis of these special alloys and their fundamental properties, to their engineering characteristics and applications.
This work will therefore be of equal interest to those who wish to become fully acquainted with the subject, and to those who are already actively engaged in the field.

DISPERSION-STRENGTHENED ALUMINIUM PREPARED BY MECHANICAL ALLOYING

Michal Besterçi, Institute of Materials Research, Slovak Academy of Sciences, Kosice
In the book, the author describes the theoretical and technological fundamentals of mechanical alloying the Al-C system. Special attention is given to material characteristics, the kinetics and mechanism of mechanical alloying, methods of mixture compaction and heat treatment of compacted parts. Models of dispersoid spatial arrangement, dispersoid evaluation and optimisation and experimental possibilities are discussed. The interpretation of the static and dynamic mechanical properties, especially strength and ductility properties at 20 °C, mechanical properties at elevated temperatures are discussed, with emphasis on the effect of interface, superplasticity, creep and creep-fatigue characteristics. Content

Introduction

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Cambridge International Science Publishing 7 Meadow Walk, Great Abington, Cambridge CB1 6AZ, England Fax +44 1223 894539; Tel +44 1223 893295 Email: cisp@cisp.demon.co.uk
<http://www.demon.co.uk/cambsci/homepage.htm>

"Mechanical Alloying"

Auteurs : Li Lü & Man On Lai(National University of Singapore)
Kluwer Academic Publishers
Contents : Preface - Introduction to Mechanical Alloying - Experimental Set - Up - The Mechanical Alloying Process - Formation of New Materials - Characterization of Powders - Densification - Mechanical Properties - Mechanisms of Mechanical Alloying - Modeling of Mechanical Alloying - Index

"Surface-Controlled Nanoscale Materials for High-Added-Value Applications"

Editors: Kenneth E. Gonsalves, Marie-Isabelle Baraton, Rajiv Singh, Heinrich Hofmann, Jerry X. Chen, and Joseph A. Akkara.

Materials Research Society, Symposium Proceedings Volume 501, 1998
MRS, Warrendale, Pennsylvania, USA (website: <http://www.mrs.org/>)

"Nanomatériaux"

Auteurs : E. Gaffet, S. Begin - Colin, O. Tillement

Editeur : Innovation 128 - 24 Rue du Quatre Septembre - 75002 Paris - France - Fax : 33 1 42 65 47 76

Les dernières années ont vu apparaître dans le monde des matériaux avancés le préfixe "nano" (nanostructuré, nanocristallins, nanophase ou nanométrique) ; les conférences et les forums sur Internet se multiplient où s'échangent des informations sur les avancées scientifiques et technologiques dans ce domaine des matériaux nanostructurés qui se distinguent des matériaux polycristallins conventionnels par la dimension des cristallites les composant ou par la dimension des hétérostructures présentes : ces dimensions sont de quelques dizaines d'ångströms, voire de quelques nanomètres. A ces dimensions, les propriétés des matériaux changent radicalement.

Au début des années 90, les japonais ont été les premiers à lancé d'ambitieux programmes de R & D puisque le MITI a consacré aux nanomatériaux près de 200 millions de dollars pour la période 1990 - 2000 et que la Science & Technology Foundation a investi presque la même somme pour co - financer des projets de laboratoires publics et privés. Les Etats Unis puis les pays européens ont investi plus tardivement mais déjà ont obtenu des résultats prometteurs (.....) Certaines applications existent déjà au niveau international, quelque 400 sociétés se partagent aujourd'hui un marché voisin de 1 milliard de dollars mais qui devrait tripler, voire quintupler à l'horizon 2001.(.....)

(...) Pour aider les industriels concernés à imaginer les applications qu'ils pourraient s'approprier et identifier les acteurs internationaux, la présente étude dresse un état de l'art complet des nanomatériaux en décrivant leurs procédés d'élaboration actuels ou envisagés et en détaillant leurs différentes propriétés physico - chimiques et les géométries que l'on peut obtenir.

Enfin l'étude permet de cerner les applications actuelles et potentielles...

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)

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, (.....)

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

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

Périodiques

(Rubrique réalisée grâce aux moyens de la bibliothèque de
l'Université de Technologie de Belfort - Montbéliard / UTBM)

[44] AN EXPERIMENTAL STUDY ON MOLECULAR DYNAMICS SIMULATION IN NANOMETER GRINDING

S Yu, B Lin, Q Guan, K Cheng - 16TH INTERNATIONAL CONFERENCE ON COMPUTER - AIDED PRODUCTION ENGINEERING - CAPE 2000 (Series: IMECHE CONFERENCE TRANSACTIONS), 2000, Vol 2000, Iss 5, pp 155-162 - 16TH INTERNATIONAL CONFERENCE ON COMPUTER-AIDED PRODUCTION ENGINEERING (CAPE 2000); EDINBURGH, SCOTLAND. AUGUST 7-9, 2000

Molecular dynamics method which is different to continuous linear mechanics is employed to survey the features of grinding energy dissipation, grinding forces, stress state and grinding temperature in the atomic space, and then explain the micro-scale mechanism of material removal and surface generation. The research shows that the atoms of the lattice reconstituting and some non-crystal layer are piled up on the front of the abrasive grain, as a result of the continuous advancement of the abrasive grain, the material are removed and formed the grinding chips. The degenerating layer of machined surface are formed with the reconstituting of non-crystal atoms and fracture atomic bonds, it consists of outer non-crystal and inner lattice deformation layers.

[43] CYCLIC CHARGE AND DISCHARGE STABILITY OF NANOCRYSTALLINE Mg₂Ni ALLOY

Authors Z Dehouche, J Goyette, TK Bose, S Boily, J Huot, R Schulz - HYDROGEN ENERGY PROGRESS XII, VOLS 1 - 3, 1998, pp 1055-1063 - 12TH WORLD HYDROGEN ENERGY CONFERENCE; BUENOS AIRES, ARGENTINA. JUNE 21-26, 1998

The hydrogen storage properties and the cyclic charge and discharge capability of the nanocrystalline Mg₂Ni alloy powder prepared by high energy ball milling is examined to evaluate the potential use of these materials in vehicular applications. Repetitive hydriding and dehydriding of nanocrystalline Mg₂Ni alloy is performed at different cycling temperature and pressure of absorption and desorption. It was found that the cycling did not affect the kinetic rates of absorption/desorption. X-ray crystal structure analysis and pressure concentration isotherms of the alloy, after initial activation and after 2100 cycles, reveal significant changes in the dynamic phase structure and the thermodynamic properties. In addition to these experiments, we have also performed BET specific surface area and specific heat characterization. These have indicated that the changes in volume during the 2100 hydriding/dehydriding cycles do not produce severe decrepitation. However, inherent deterioration in the charge capacity of the alloy, apparently related to the formation of the MgNi₂ phase, was observed.

[42] EFFECT OF PROCESSING PARAMETERS ON MG-BASED HYDROGEN STORAGE MATERIALS PREPARED BY MECHANICAL ALLOYING

K Sapru, L Ming, J Evans, NT Stetson - HYDROGEN ENERGY PROGRESS XII, VOLS 1 - 3, 1998, pp 1183-1192 - 12TH WORLD HYDROGEN ENERGY CONFERENCE; BUENOS AIRES, ARGENTINA. JUNE 21-26, 1998

Magnesium and its alloys are promising candidate materials for the reversible storage of hydrogen. Alloys having the desired properties and economics will find widespread applications such as for use in fuel cells and hydrogen internal combustion engines. Several Mg-based alloys were prepared by the mechanical alloying process. We will report on the effects of various processing parameters utilized during mechanical alloying, on the structure and morphology of the materials produced. Results on the hydrogen storage properties of these materials will also be presented.

[41] ZNO VARISTORS PREPARED BY DIRECT MIXING OF CONSTITUENT PHASES

Authors Brankovic Z. Milosevic O. Poleti D. Karanovic L. Uskokovic D. - Materials Transactions Jim. 41(9):1226-1231, ZnO varistors with non-linearity coefficients reaching 50 and low values of the leakage current (similar to 0.01 A/m²), were obtained by a method referred to as "direct mixing of constituent phases". The method is based on sintering of a mixture of the constituent phases with the following compositions: ZnO phase uniformly doped with Co²⁺ and Mn²⁺; intergranular phase: gamma -Bi₂O₃ stabilized with Mn²⁺ or Zn²⁺; spinel phase: Zn_{1.971}Ni_{0.090}Co_{0.030}Cr_{0.247}Mn_{0.090}Sb_{0.545}O₄ AS proved, the obtained varistors are composed of the same phases as those introduced into the system. The influence of composition as well as milling and sintering parameters on the varistor characteristics were investigated. Some varistor powder mixtures were intensively milled before sintering. As a result, high density ceramics with highly homogeneous microstructure were obtained after sintering.

[40] MICROSTRUCTURE AND MECHANICAL PROPERTIES OF MOSI₂/NB COMPOSITES MADE BY MA-PULSE DISCHARGE SINTERING

Park YH. Haskimoto H. Hahn YD. - Materials Transactions Jim. 41(9):1268-1273,

MoSi₂ is one of the most promising candidates for high-temperature structural materials because of its high melting point and excellent oxidation resistance. However, the low room temperature fracture toughness and ductility, etc., still remain as major disadvantages to potential high temperature structural applications. MoSi₂ composites containing Nb have shown a great improvement in mechanical properties, especially in fracture toughness, over the monolithic MoSi₂. However, the addition of refractory metals such as Nb or W has not been that acceptable because of the high reactivity of these additions with the MoSi₂ matrix, and the deleterious effect of reducing oxidation resistance and increasing density. Also, Nb reinforced MoSi₂ composites resulted in a penalty with decreasing strength, both at room and elevated temperatures. In the present study, MoSi₂ and MoSi₂-Nb powders with a fine grain size were prepared by mechanical alloying. In order to retain the fine microstructure in the consolidated samples, pulse discharge sintering was used to consolidate these powders at a lower sintering temperature compared to that of the conventional hot pressing or HIP. The grain size of the consolidated MoSi₂-10Nb composite was 0.18 to 1.2 μm, which was finer than that of monolithic MoSi₂, 1.5 to 3.0 μm. The formation of the (MoNb)₅Si₃ phase was pronounced in the Nb added composites, and this phase seemed to be formed

during the sintering process. Both monolithic MoSi₂ and MoSi₂-10Nb composites from the mechanically alloyed powders showed a significant amount of plastic deformation in a bending test at 1073 K. The yield stress of the Nb added alloy was higher than that of the monolithic MoSi₂, which may be caused by the refinement of the microstructure

[39] CONSOLIDATION OF TI-35 AT%FE-5 AT%B-5 AT%SI POWDER SYNTHESIZED BY MECHANICAL GRINDING [JAPANESE]

Authors Kobayashi K. Matsumoto A. Nishio T. Ozaki K. Sugiyama A. - Journal of the Japan Institute of Metals. 64(9):723-726,

Ti-35 at%Fe-5 at%B-5 at%Si alloy synthesized by a cold crucible levitation melting furnace was mechanically ground (MG) for 360 ks by using a planetary ball mill. The obtained powder consisted of an amorphous phase and a crystalline one. The amount of the amorphous phase in the MG powder increased as increasing milling time. The crystallization temperature of Ti-35 at%Fe-5 at%B-5 at%Si powder milled for 360 ks was 673 K. The MG powder after milling for 360 ks was packed into a stainless steel pipe and set up in the chamber of a pulsed current sintering (PCS) machine. Continuously, the powder was consolidated at 573 K with a high pressure application of 1568 MPa using PCS process, accompanied with deformation of the pipe. An obtained compact had a thickness of 1 mm and contained only about 6 vol% pores. An exothermic reaction was observed at nearly 673 K for the DSC trace of the compact, which indicated the amorphous phase remained in the compact

[38] THE AMORPHIZATION OF LN-SI (LN=RARE EARTH METAL) ALLOY POWDERS BY MECHANICAL ALLOYING [JAPANESE]

Authors Arakawa T. Aramaki Y. - Journal of the Japan Institute of Metals. 64(9):755-758,

Crystalline powders of Si and Ln (Ln = Sm, Nd, Gd, Tb, Dy, Er) in the composition ratio Si:Ln = 2 : 1 were mechanically alloyed in an inert atmosphere using a laboratory ball mill. The progress of the mechanical alloying was identified by X-ray diffraction. The amorphization reaction between Si and Ln proceeded according to a second-order formula. The sequence of the rate of amorphization reaction for the Si-Ln system was Sm>Gd>Tb>Nd greater than or equal to Dy>Er. The reaction rate was affected by the crystal structure of Ln. In the case of Gd, Tb, Dy and Er having the same structure (hexagonal closed packed), the reaction rate was correlated to the volume ratio (V-Ln/V-Si). In the Sm-Si system, which had the fastest MA rate, Sm has a unique structure in which triangular planes of Sm atoms overlap fourfold and would be easily attacked by Si atoms. In Nd-Si system, the rate would be affected by the structure of double hexagonal closed packed of Nd. The crystallization of Si-Ln was studied by means of X-ray diffraction, differential thermal analysis and electrical resistivity measurement

[37] SYNTHESIS OF COMPOSITE METAL HYDRIDE ALLOY OF A(2)B AND AB TYPE BY MECHANICAL ALLOYING

Han SS. Goo NH. Jeong WT. Lee KS. - Journal of Power Sources. 92(1-2):157-162,

A composite alloy composed of Mg₂Ni and TiNi phases has been synthesized directly from elemental powders of Mg, Ni and Ti by mechanical alloying. The alloyed powders are produced by milling for 20 h. Most of the powders are not a perfect composite state but a mixture of Mg₂Ni and TiNi grains. The amount of the Mg₂Ni phase is relatively less than that of the TiNi phase because more Mg forms a solid-solution with TiNi than Ti forms with Mg₂Ni. The maximum discharge capacity of the composite electrode is 380 mAh g⁻¹ at a discharge current density of 10 mA g⁻¹. This value is higher than that of a mechanically alloyed Mg₂Ni electrode. The composite electrode shows improved cycle-life compared with single-phase Mg₂Ni. For example, after 150 cycles the ratio of the discharge capacity to the maximum value is about 55% whilst the ratio for Mg₂Ni is below 10%. The composite electrode also has a high-rate discharge capability which is about 100 mAh g⁻¹ after 40 cycles, regardless of the discharge current density.

[36] EFFECT OF MECHANICAL MILLING OF GRAPHITE POWDER ON LITHIUM INTERCALATION PROPERTIES

Natarajan C. Fujimoto H. Mabuchi A. Tokumitsu K. Kasuh T. - Journal of Power Sources. 92(1-2):187-192,

Mechanically milled graphite powder for different durations was used as anode in lithium-ion battery. Reversible capacity and coulombic efficiency of the milled and pristine powders were measured. It was found that the controlled milling increases the reversible capacity and coulombic efficiency of the first cycle from 356 to 368 Ah kg⁻¹ and from 83 to 86%, respectively. The milled powder was analyzed for particle size distribution, bulk and surface structure by particle size analyzer, powder X-ray diffractometer, and Raman spectroscopy and electron microscope, respectively, to understand the effect of mechanical milling of graphite powder on its physical properties. The mild milling lead to aggregation of graphite particles, that had significant influences on the electrode performance. Graphite-tin dioxide composite electrode has also been prepared by the mechanical milling and the preliminary result indicates that the mechanical milling would be used to prepare the high capacity composite electrodes

[35] HYDROGEN STORAGE MATERIAL BASED ON LANI5 ALLOY PRODUCED BY MECHANICAL ALLOYING

Simicic MV. Zdujic M. Jelovac DM. Rakin PM. - Journal of Power Sources. 92(1-2):250-254,

The electrochemical characteristics of the La_{0.8}Ce_{0.2}Ni_{2.5}Co_{1.8}Mn_{0.4}Al_{0.3} compound, produced by mechanical alloying, are investigated for hydrogen storage in nickel-metal hydride (NiMH) batteries by discharging tests at constant current and by calculating equilibrium pressure of hydrogen from the equilibrium potentials. It is shown that the alloy produced by mechanical alloying, followed by annealing and activation exhibits high specific capacity at the stable potential plateau, even at the high discharge rate (10 mA cm⁻²), and low hydrogen equilibrium pressure. The alloy of such composition gives low capacity loss during cycling, which enables its application for metal hydride battery production

Author e-mail Address elbkong@ntu.edu.sg

[34] SYNTHESIS OF COMPOSITE METAL HYDRIDE ALLOY OF A(2)B AND AB TYPE BY MECHANICAL ALLOYING

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[31] PBTIO₃ CERAMICS DERIVED FROM HIGH-ENERGY BALL MILLED NANO-SIZED POWDERS

Kong LB. Zhu W. Tan OK. - Journal of Materials Science Letters. 19(21):1963-1966,

[30] MECHANOCHEMICAL SYNTHESIS AND SINTERING BEHAVIOUR OF MAGNESIUM ALUMINATE SPINEL

Mackenzie KJD. Temuujin J. Jadambaa T. Smith ME. Angerer P. - Journal of Materials Science, 35(22):5529-5535, 2000 X-ray amorphous precursor phases for the synthesis of spinel (MgAl₂O₄) have been prepared by grinding mixtures of gibbsite (Al(OH)₃) with brucite (Mg(OH)₂) or hydromagnesite (4MgCO₃·Mg(OH)₂·4H₂O). The mechanochemical treatment does not remove any water or carbonate, but converts some of the gibbsite octahedral Al sites into tetrahedral sites and other sites with a (2)7Al MAS NMR resonance at about 38 ppm. The brucite-derived precursor forms spinel on heating at less than or equal to 850°C, by contrast with unground mixtures which show little spinel formation even at 1250°C. The hydromagnesite-derived precursor transforms at about 850°C into a mixture of spinel and hydrotalcite (Mg₆Al₂(OH)₁₆CO₃·4H₂O), the latter decomposing to spinel and MgO by 1050°C. Spinel derived from the hydromagnesite-containing precursor shows superior pressureless sintering properties at 1400-1600°C, producing a body of 97% theoretical bulk density at 1600°C. Under the same conditions, the brucite-derived spinel sintered to 72% theoretical density and showed a morphology consisting of widely disparate grain sizes

[29] IMPROVEMENT OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF AZ91/SiC COMPOSITE BY MECHANICAL ALLOYING

Li L. Lai MO. Gupta M. Chua BW. Osman A. - Journal of Materials Science. 35(22):5553-5561,

AZ91 magnesium alloy reinforced with SiC particulates was fabricated via powder metallurgy technique as well as mechanical alloying process where a planetary ball mill was employed. Microstructure and mechanical properties of the fabricated AZ91 composites had been evaluated. Microstructural study showed that grain size of the material was refined and SiC particulates were well distributed after mechanical alloying. Mechanical tests of the composite showed an enhanced yield and ultimate tensile strengths for the mechanically alloyed samples compared with those prepared via the powder metallurgical route

[28] MECHANOCHEMISTRY OF CATALYSTS [REVIEW] [RUSSIAN]

Molchanov VV. Buyanov RA. - Uspekhi Khimii. 69(5):476-493, 2000

Data on the use of mechanochemical activation for preparation of catalysts and supports are generalised. The influence of mechanochemical activation on the catalytic properties of various systems is noted. Catalytic reactions occurring under conditions of mechanochemical activation are discussed. The hypotheses concerning the nature of the effect of mechanochemical activation on the reactivity (including catalytic properties) of solids are considered.

[27] MECHANOCHEMICAL SYNTHESIS OF HEMIN-IMIDAZOLE COMPLEXES

Paneque A. Fernandez-Bertran J. Reguera E. Yee-Madeira H. - Transition Metal Chemistry. 26(1-2):76-80, 2001

Solid state reactions of hemin and imidazole were performed by milling the crystalline materials in an agate mortar. The process was monitored by i.r., x.r.d. and Mossbauer spectroscopies. Samples with different hemin to imidazole molar ratios were studied. The interactions of imidazole with the central Fe atom and with the propionic acid groups in the periphery of the hemin molecule were detected. The latter interactions are suppressed by washing with MeOH. Complexes with 1:2 and 1:4 hemin-to-imidazole molar ratios were identified.

[26] ON THE RELATIONSHIP BETWEEN THE HYSTERESIS LOOP SHIFT AND THE DIPOLAR INTERACTIONS IN HARD-SOFT NANOCOMPOSITE SAMPLES

Gonzalez JM. Montero MI. Raposo V. Hernando A. -Journal of Magnetism & Magnetic Materials. 221(1-2):187-195, 2000

We report on the hysteretic and relaxational behavior of Fe-Ba hexaferrite nanocomposite samples prepared by ball milling. This includes data on the temperature dependence of the coercive force, on the relationship between the field evolution of the isothermal and the demagnetization remanences and on the time evolution of the magnetization at those remanences. Our most remarkable result corresponds to the observation, at room temperature and without held cooling the samples, of a displacement (in the sense of the negative fields) of the hysteresis loops measured under a maximum applied field of 0.8 T. The magnitude of that shift oscillates when the Fe content changes. Our results are analyzed in terms of the occurrence of interphase dipolar interactions.

[25] MAGNETIC BEHAVIOUR AND PERCOLATION IN MECHANICALLY ALLOYED FE-SiO₂ GRANULAR SOLIDS

Salonso-Sanudo M. Blackwell JJ. O'Grady K. Gonzalez JM. Cebollada F., Morales MP. - Journal of Magnetism & Magnetic Materials. 221(1-2):207-214, 2000

In this paper we report a study of the coercivity of Fe-SiO₂ granular solids, with Fe volume concentrations between 0.2 and 0.6, and mean grain sizes varying from 15 to 18 nm. These samples present very high switching fields of the order of 1 kOe, being higher for the magnetization processes than for the demagnetization ones. The analysis of the switching field distributions and the calculation of the activation volumes have proved that the reversal mechanism is the same for all samples, either above or below the percolation threshold ($x = 0.5$), and involves the full volume of individual particles, aided by dipolar fields that are of a few hundred Oe, in the case of the demagnetization processes.

[24] STRUCTURAL DISORDER IN THE HIGH-ENERGY MILLED MAGNESIUM FERRITE

Sepelak V. Baabe D. Litterst FJ. Becker KD. - Journal of Applied Physics. 88(10):5884-5893, 2000

The structural and magnetic evolution in magnesium ferrite (MgFe₂O₄) caused by high-energy milling are investigated by Mossbauer spectroscopy. It is found that the nanostructural state of the milled MgFe₂O₄ is characterized by a mechanically induced cation redistribution between tetrahedral (A) and octahedral [B] sites. The reduced concentration of iron ions at (A) sites in the mechanically treated samples leads to the variation in the number of magnetic and nonmagnetic (A)-site ions as nearest neighbors of the Fe³⁺[B] ions. This results in a broad distribution of magnetic hyperfine fields at the [B] sites. In addition to the local magnetic fields B(6), B(5), and B(4) characteristic of nonactivated ferrite and corresponding to Fe³⁺[B] ions with $n=6, 5,$ and 4 nearest (A)-site iron neighbors, respectively, the distribution curves of mechanically treated samples show additional components at smaller magnetic fields. The weight of the B(6) field decreases with increasing milling time, and the B(5) field becomes the most probable hyperfine field component in the distribution curve of the mechanically activated samples. The degree of inversion in MgFe₂O₄ is calculated from the probabilities of the different [B]-site surroundings as well as from the Mossbauer subspectral areas. Excellent agreement is obtained in the two independent procedures for the determination of the cation distribution. This enables us to separate from the [B]-site magnetic field distribution profile the contribution arising from the mechanically induced "new" nearest-neighbor (A)-site configuration with $n=3$ nearest (A)-site iron neighbors. Taking into account the nanoscale nature of the mechanically activated MgFe₂O₄, the observed spin canting, which increases with increasing milling time, is attributed to the noncollinear spin structure of the near-surface atoms. In strongly activated ferrite, the magnetic hyperfine splitting breaks down totally and the Mossbauer spectrum is dominated by a superparamagnetic relaxation effect.

[23] CHANGE IN ANTIBACTERIAL CHARACTERISTICS WITH DOPING AMOUNT OF ZNO IN MGO-ZNO SOLID SOLUTION

Yamamoto O. Sawai J. Sasamoto T. - International Journal of Inorganic Materials. 2(5):451-454, 2000

Antibacterial activity for MgO-ZnO solid solution was studied by measuring the change in electrical conductivity with bacterial growth. MgO-ZnO solid solution powders were prepared by heating at 1400 degreesC for 3 h in air. A single phase with cubic type structure was obtained in the weight ratio range (MgO/ZnO) of 4.0 and 1.5, but the ratio of 0.67 resulted in a ZnO phase in addition to solid solution. After milling the solid solution powders by planetary ball mill, the average particle size and the specific

surface area of these powders became 0.1 μm and 26 m^2/g , respectively, which were used in the test of antibacterial activity. From the results of antibacterial tests, the activity increased with increasing the powder concentration in the medium. With increasing the doping amount of ZnO in MgO-ZnO solid solution, it was found to show a decrease in the antibacterial activity against Escherichia coli and Staphylococcus aureus. The pH value in physiological saline at the powder concentration of 2.5 mg/ml showed the alkali region above 10.0, and decreased with the increase of ZnO amount in solid solution. The decrease in antibacterial activity, therefore, was associated with the decrease of pH value in medium

[22] EFFECT OF ATMOSPHERE ON THE MECHANICAL MILLING OF NATURAL GRAPHITE

Ong TS. Yang H. - Carbon. 38(15):2077-2085, 2000.

Natural graphite was ball milled in a vibratory and a planetary mill under different atmospheres. Its microstructure was found to evolve very differently when milled in oxygen and in an inert atmosphere. This phenomenon is most pronounced when it was milled in a planetary mill where the deformation forces are mainly shear in nature. Mechanically induced oxidation on the surface, probably along the edges of the graphene planes, is responsible for suppressing the fracture rate and preserving the crystallinity of natural graphite milled in oxygen. Understanding this mechanochemical process may open up a new route for the synthesis of carbonaceous materials suitable for lithium ion battery applications.

[21] TRANSFER, MIXING AND ASSOCIATED CHEMICAL AND MECHANICAL PROCESSES DURING THE SLIDING OF DUCTILE MATERIALS

Rigney DA. - Wear. 245(1-2 Special Issue SD):1-9, 2000

This paper is based on a presentation designed to stimulate discussion among participants in an international symposium held at Hyderabad, India, 14-16 December 1998. The program focused on the genesis and role of transfer and mechanical mixing in the wear of materials. It is convenient to divide the changes arising from sliding contacts into two broad categories, the first in which the average chemical composition is unchanged and the second in which the chemical composition is modified by interactions with the counterface material and the environment. These are not completely independent. In fact, plastic deformation and changes in structure during early stages of sliding may be precursors to processes such as transfer and mechanical mixing in which the chemical composition of near-surface material is modified, together with further changes in structure, and further deformation of the tribo-chemically modified material. Also, one part of a wearing surface may have a given combination of chemical composition and structure, while a nearby one may have another. Advances in understanding sliding behavior have been greatly aided by the recent availability of improved techniques for structural, chemical and mechanical characterization of materials. There is now abundant evidence for large plastic strains, allowed by the imposed compressive and shear stresses, even in materials which are considered to be brittle in simple tensile tests. Thus, sliding encourages ductility adjacent to the sliding interface. The energy dissipated during continuing plastic deformation can account for the values of friction coefficients typically measured during the unlubricated sliding of ductile materials. To improve our understanding of sliding wear processes, it is helpful to monitor changes in structure and chemical composition of sliding test specimens and wear debris, using very short to very long sliding times and using both in situ and post-test techniques. Such work has suggested that sliding wear commonly involves development of a deformation substructure which is susceptible to shear instabilities, leading to transfer, chemical reactions, mechanical mixing and fracture. The processes are similar to those which occur in the early stages of the commercial process known as mechanical alloying. Evidence for such processes has

accumulated over many years and is now more than sufficient to justify major efforts to incorporate transfer and mixing in quantitative wear models. Questions designed to stimulate such efforts are included in this paper.

[20] INVESTIGATION OF THE DIRECT HYDROMETALLURGICAL PROCESSING OF MECHANICALLY ACTIVATED LOW-GRADE WOLFRAMITE CONCENTRATE

Amer AM. - Hydrometallurgy. 58(3):251-259, 2000

Experimental laboratory work on leaching of low-grade wolframite concentrate has shown that the dissolution of tungsten with a high extraction (90%) can only be reached after mechanical treatment of the studied wolframite concentrate, following oxidative leaching at 170 degreesC in an autoclave in the presence of oxygen partial pressure of 10 bar. The effects of grinding time, temperature, sodium hydroxide concentration and oxygen partial pressure on the oxidation rate as well as the kinetics of the leaching process have been determined.

[19] MAGNETIC PROPERTIES STUDY OF NANOCRYSTALLINE COBALT AND COBALT - BASED ALLOYS"

N. Fenineche, O. EL Kedim, E. Gaffet - J. Metastable et Nanocrystalline Materials, 7 (2000) 41 - 48

[18] THE INFLUENCE OF MECHANICAL TREATMENT ON THE ABSORPTION OF CO₂ BY PEROVSKITE OXIDES

Nomura K. Tokumitsu K. Hayakawa T. Homonnay Z. - Journal of Radioanalytical & Nuclear Chemistry. 246(1):69-77, 2000

Perovskite oxides of composition (Sr_{1-x}Ca_x)(Fe_{0.5}Co_{0.5})O_{3-δ} were investigated for CO₂ absorption properties and were proved to be useful as materials for CO₂ absorption in the temperature range from 550 to 850 degreesC. The absorption rate of CO₂ increased with Ca doping. The mechanical treatment of perovskite oxides for several minutes, especially for the oxides containing a small amount of Ca, was found to be effective for activating the oxides for CO₂ absorption and for reducing the starting temperature of CO₂ absorption by about 80 degreesC. However, it was not less effective to treat the oxides for a long time. The site distortion due to Sr and Ca ions at site A and the mixed valence states at site B were confirmed to be effective for CO₂ absorption at high temperatures. During the absorption of CO₂, a spinel compound was formed according to the following reaction: 2(Sr,Ca)(Fe,Co)O-2.5 + CO₂ --> (Sr,Ca)CO₃ + (Sr,Ca)(Fe,Co)(2)O-4.

[17] MECHANOCHEMICAL OXIDATION OF ORGANIC MODEL COMPOUNDS BY MEANS OF POTASSIUM PERMANGANATE [GERMAN]

Nuchter M. Ondruschka B. Trotzki R. - Journal fur Praktische Chemie-Practical Applications & Applied Chemistry. 342(7):720-724, 2000

Systematical investigation of solvent-free oxidations of organic model compounds with potassium permanganate on inorganic carriers leads to conclusion, that mechanochemical stimulation can induce oxidations. In case of the benzyl-type arenes these conversions are selective at good yields. Olefines react to carbonic acids. The presence of water enhances the yield of almost all educts.

[16] PHASE STATE AND MAGNETIC CHARACTERISTICS OF FINELY DISPERSED IRON POWDERS PREPARED BY MECHANICAL ACTIVATION IN ORGANIC MEDIUM IN THE PRESENCE OF SURFACTANT

Lomaeva SF. Elsukov EP. Konygin GN. Dorofeev GA. Zagainov AV. Povstugar VI. Mikhailova SS. Maratkanova AN. - Colloid Journal. 62(5):579-587, 2000

The effect of a surfactant (oleic acid) on the dispersity, structure, phase composition, and magnetic properties of powders prepared by iron grinding in the medium of liquid hydrocarbon (heptane) in a planetary ball mill was studied by the methods of X-ray diffraction analysis, Mossbauer and Auger spectroscopy, secondary ion mass spectrometry, and by magnetic measurements. It was shown that the presence of surfactant results in an increase in dispersity, a change in the shape of particles, and in their magnetic properties. Coercive force increases 20-fold and specific saturation magnetization decreases twofold after a 99-h grinding. The powders prepared possess a nanocrystalline structure (grain size 4 nm) and represent supersaturated solid solutions of oxygen and carbon in bcc-iron with inclusions of iron carbide Fe₃C. The concentration of impurities introduced by heptane (C) and oleic acid (C, O) rises with an increase in the duration of grinding. It was demonstrated that changes in magnetic characteristics depend on the content of impurities in powders, as well as on the size and shape of particles obtained.

[15] SOLID-STATE INTERACTION BETWEEN ACID TANTALUM PHOSPHATE AND ALKALI METAL CHLORIDES

Tarnopolskii VA. Ketsko VA. Kislitsin MN. Kotov VY. Yaroslavtsev AB. Russian Journal of Inorganic Chemistry. 45(10):1487-1491, 2000

The processes accompanying thermal treatment in the HTa(PO₄)₂ · 2H₂O + MCl (M = Na, K, Rb, Cs) systems were investigated. It was found that mechanochemical ion-exchange interaction proceeds in these mixtures in the course of grinding. Introducing alkali metal cations into the phosphate crystal lattice during the mechanochemical treatment increased the dehydration temperature of the acid tantalum phosphate and decreased the onset temperature of ion exchange. In contrast to the samples obtained by mixing two separately ground reagents, ion exchange in the mechanically treated samples proceeds in two stages. The diffusivities of cations in the products of exchange were evaluated at 430, 460, and 490 degreesC. The calculated diffusivity for the specified temperature range tends to increase with increasing radius of the alkali metal cation.

[14] MECHANOCHEMICAL SYNTHESIS AND CHARACTERIZATION OF POLY(VINYL CHLORIDE)-BLOCK-POLY(ETHYLENE-CO-PROPYLENE) COPOLYMERS BY ULTRASONIC IRRADIATION

Fujiwara H. Minamoto Y. - Polymer Bulletin. 45(2):137-144, 2000

Mechanical degradation and mechanochemical reaction in heterogeneous and homogeneous systems of poly(vinyl chloride) and poly(ethylene-co-propylene) polymer have been studied by ultrasonic irradiation at 30 degrees C. The rates of decrease in the number-average molecular weights of the degraded poly(vinyl chloride) and poly(ethylene-co-propylene) polymer were much faster in order of the solid poly(vinyl chloride)-poly(ethylene-co-propylene) polymer solution, the swelled poly(vinyl chloride)-poly(ethylene-co-propylene) polymer solution, and the homogeneous solution systems. On the other hand, mechanochemical reaction occurred by free radicals produced from the chain scissions of both polymers by ultrasonic waves. The changes in the composition of the total block copolymer, the unreacted poly(vinyl chloride), and the unreacted poly(ethylene-co-propylene) polymer in individual reaction systems were obtained. In addition, the microscopic observation of the surfaces of the polymers on before and after mechanochemical reaction is carried out.

[13] CORRELATION OF MICROSTRUCTURE WITH DYNAMIC DEFORMATION BEHAVIOR AND PENETRATION PERFORMANCE OF TUNGSTEN HEAVY ALLOYS FABRICATED BY MECHANICAL ALLOYING

Kim DK. Lee S. Ryu HJ. Hong SH. Noh JW. - Metallurgical & Materials Transactions A-Physical Metallurgy & Materials Science. 31(10):2475-2489, 2000

In this study, tungsten heavy alloy specimens were fabricated by mechanical alloying (MA), and their dynamic torsional properties and penetration performance were investigated. Dynamic torsional tests were conducted on the specimens fabricated with different sintering temperatures after MA, and then the test data were compared with those of a conventionally processed specimen. Refinement of tungsten particles was obtained after MA, but contiguity was seriously increased, thereby leading to low ductility and impact energy. Specimens in which both particle size and contiguity were simultaneously reduced by MA and two-step sintering and those having higher matrix fraction by partial MA were successfully fabricated. The dynamic test results indicated that the formation of adiabatic shear bands was expected because of the plastic localization at the central area of the gage section. Upon highspeed impact testing of these specimens, self-sharpening was promoted by the adiabatic shear band formation, but their penetration performance did not improve since much of kinetic energy of the penetrators was consumed for the microcrack formation due to interfacial debonding and cleavage fracture of tungsten particles. In order to improve penetration performance as well as to achieve self-sharpening by applying MA, conditions of MA and sintering process should be established so that alloy densification, particle refinement, and contiguity reduction can be simultaneously achieved.

[12] CHARACTERIZATION OF FE3Al-BASED INTERMETALLIC ALLOYS FABRICATED BY MECHANICAL ALLOYING AND HIP CONSOLIDATION

Zhu SM. Tamura M. Sakamoto K. Iwasaki K. *Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing*, 292(1):83-89, 2000

Fe₃Al-based alloys with and without Ti addition were synthesized by hot isostatic pressing (HIP) of mechanically alloyed nanocrystalline powders. An ultra-high pressure (1 GPa) HIP equipment was used in an effort to consolidate the mechanically alloyed powders into fully dense compacts while retaining the nanocrystalline microstructure. The densification of powders was found to depend largely on the HIP temperature. Fully dense compacts with a grain size of about 200 nm were obtained after HIP treatment at 1073 K. Mechanical properties of the compacted materials at room and elevated temperatures were determined by hardness and compression tests. Ti addition significantly increased the hardness and room temperature yield strength, but this increase was accompanied by a reduction in ductility. The yield strength decreased monotonically with increasing temperature with no positive temperature dependence observed. The high temperature deformation processes were investigated by examining the strain rate sensitivity and the deformation microstructure. Compared with the binary Fe₃Al, the Ti-added alloy exhibited lower strength but better deformability at temperatures above 1073 K.

[11] NANOSCALE SURFACE MODIFICATION AND NANOSTRUCTURAL FABRICATION OF YBa₂Cu₃O_{7-x} THIN FILMS BY SCANNING TUNNELING MICROSCOPY

Fan YC. Fitzgerald AG. Cairns JA. - *Journal of Vacuum Science & Technology B*, 18(5):2377-2383, 2000

The scanning tunneling microscope has been used to modify the surface of YBa₂Cu₃O_{7-x} (YBCO) high T_c superconducting thin films by operating the instrument in the so-called mechanical milling or field-induced evaporation mode. Nanostructures such as holes, lines, and trenches were fabricated on the YBCO thin film surface in a controlled manner. In the surface modification and nanostructure fabrication processes, the effect of bias voltage, tunneling current, and scanning feedback control parameters on the modification efficiency have been investigated.

[10] EFFECT OF GRINDING ON SYNTHESIS OF MgAl₂O₄ SPINEL FROM A POWDER MIXTURE OF Mg(OH)₂ AND Al(OH)₃

Kim W. Saito F. - *Powder Technology*, 113(1-2):109-113, 2000

Dry grinding of the powder mixture composed of magnesium hydroxide and gibbsite using a planetary ball mill followed by its heating was conducted to prepare MgAl₂O₄ spinel. Both the starting materials are easily converted to amorphous phase by intensive grinding within 60 min. The monolithic MgAl₂O₄ spinel phase can be obtained from the mixtures ground over 15 min by calcination at 900 degreesC. The reactivity of the mixtures ground over 30 min is not improved. Prolonged grinding promotes the aggregation of ground fine particles, but the aggregates deflocculate into fragments after calcination.

[9] MECHANOCHEMICAL ACTIVATION OF INDUSTRIAL CATALYSTS: 1. CATALYTIC PROPERTIES OF STK, NTK-10-1, AND NICKEL-CHROMIA CATALYSTS AND THEIR MECHANICAL MIXTURES IN REDOX REACTIONS INVOLVING NITROGEN OXIDE, CARBON MONOXIDE, AND HYDROCARBONS

Tret'yakov VF. Burdeinaya TN. Vlasova YA. Kaloshkin SD. Davydova MN. - *Petroleum Chemistry*, 40(5):326-331, 2000

The effect of mechanochemical activation on the activity of mechanical mixtures of the industrial catalysts STK and NTK-10-1 and a nickel-chromia catalyst as binary compositions in the reactions of selective reduction of nitrogen oxides with propane in the presence of oxygen and severe oxidation of hydrocarbons (using toluene as an example), as well as the activity of the mechanochemical catalyst SNM-1, which is similar to the industrial catalyst in composition, in the reaction of deep oxidation of CO were examined. It was shown that the activity of catalytic compositions prepared by joint grinding of components in a planetary activator in the reaction of selective reduction of nitrogen oxides with propane substantially depended on the conditions of mechanochemical treatment (grinding body load and grinding time). At the optimum load on the materials of the system (load 1 : 5, grinding time 10 min), the activity of the catalytic compositions obtained from the catalysts NTK-10-1 and Ni-Cr oxide by the mechanochemical procedure was noted to increase as manifested by shifting the NO conversion temperature maximum to lower temperatures by 100 degrees C. It was found that the catalytic activity of mechanical mixtures and mechanochemical systems (regardless of their preparation conditions) in the reaction of deep oxidation of toluene is higher than that of the individual catalysts composing the formulations. The catalyst prepared from corresponding oxides by the mechanochemical procedure to have the same composition as the industrial catalyst SNM-1 obtained by the traditional coprecipitation method exhibits approximately the same activity as the latter in CO oxidation reaction. In the view of high environmental safety of the technology of catalyst preparation by the mechanochemical method, opportunities for the synthesis of catalysts of various compositions with properties superior to those of analogous industrial catalysts prepared by the conventional procedures and for rapid launching of production of catalysts of any prescribed composition, this method was shown to hold much promise.

[8] OPTIMISATION OF AUTOGENOUS GRINDING

Loveday BK. Dong H. - *Minerals Engineering*, 13(13):1341-1348, 2000

Batch tests in a 0.6m diameter mill were used to simulate fully autogenous primary and secondary grinding. Substantial improvements in primary mill capacity were obtained by modifying the mill contents to simulate crushing of small pebbles and recycle of the crushed material. Secondary grinding efficiency (as measured by kWh per ton finer than 75 microns or Work index), was improved substantially by reducing the pebble size to 20/28mm. The process as a whole was optimised when crushed rock coarser than 4 mm was recycled to primary mill, as the small pebbles were most efficient with "sand". The benefit of using

small grinding media has been known for some time, but the high cost and rapid consumption of small steel balls makes their use uneconomical. However a plentiful supply of small pebbles is available from a primary mill. A further and unexpected improvement in power efficiency was obtained when pebble milling was performed at 92% of critical speed.

[7] CORRELATION OF MICROSTRUCTURE WITH DYNAMIC DEFORMATION BEHAVIOR AND PENETRATION PERFORMANCE OF TUNGSTEN HEAVY ALLOYS FABRICATED BY MECHANICAL ALLOYING

Kim DK. Lee S. Ryu HJ. Hong SH. Noh JW.

Metallurgical & Materials Transactions A-Physical Metallurgy & Materials - Science. 31(10):2475-2489, 2000

In this study, tungsten heavy alloy specimens were fabricated by mechanical alloying (MA), and their dynamic torsional properties and penetration performance were investigated. Dynamic torsional tests were conducted on the specimens fabricated with different sintering temperatures after MA, and then the test data were compared with those of a conventionally processed specimen. Refinement of tungsten particles was obtained after MA, but contiguity was seriously increased, thereby leading to low ductility and impact energy. Specimens in which both particle size and contiguity were simultaneously reduced by MA and two-step sintering and those having higher matrix fraction by partial MA were successfully fabricated, The dynamic test results indicated that the formation of adiabatic shear bands was expected because of the plastic localization at the central area of the gage section. Upon highspeed impact testing of these specimens, self-sharpening was promoted by the adiabatic shear band formation, but their penetration performance did not improve since much of kinetic energy of the penetrators was consumed for the microcrack formation due to interfacial debonding and cleavage fracture of tungsten particles. In order to improve penetration performance as well as to achieve self-sharpening by applying MA, conditions of MA and sintering process should be established so that alloy densification, particle refinement, and contiguity reduction can be simultaneously achieved.

[6] CHARACTERIZATION OF FE3Al-BASED INTERMETALLIC ALLOYS FABRICATED BY MECHANICAL ALLOYING AND HIP CONSOLIDATION

Zhu SM. Tamura M. Sakamoto K. Iwasaki K. - Materials Science & Engineering A-Structural Materials Properties - Microstructure & Processing. 292(1):83-89, 2000

Fe3Al-based alloys with and without Ti addition were synthesized by hot isostatic pressing (HIP) of mechanically alloyed nanocrystalline powders. An ultra-high pressure (1 GPa) HIP equipment was used in an effort to consolidate the mechanically alloyed powders into fully dense compacts while retaining the nanocrystalline microstructure. The densification of powders was found to depend largely on the HIP temperature. Fully dense compacts with a grain size of about 200 nm were obtained after HIP treatment at 1073 K. Mechanical properties of the compacted materials at room and elevated temperatures were determined by hardness and compression tests. Ti addition significantly increased the hardness and room temperature yield strength, but this increase was accompanied by a reduction in ductility. The yield strength decreased monotonically with increasing temperature with no positive temperature dependence observed. The high temperature deformation processes were investigated by examining the strain rate sensitivity and the deformation microstructure. Compared with the binary Fe3Al, the Ti-added alloy exhibited lower strength but better deformability at temperatures above 1073 K.

[5] STRUCTURE DEVELOPMENT AND PROPERTY CHANGES IN HIGH DENSITY POLYETHYLENE - DURING PAN-MILLING

Huang H. - Journal of Applied Polymer Science. 78(11):2016-2024, 2000

A new self-designed mechanochemical reactor, inlaid pan-mill, was used in studying high density polyethylene (HDPE). The effects of pan-milling stress on the structure and properties of HDPE were investigated. Gel permeation chromatography, melt indexer, Fourier transformed infrared spectroscopy, electron spectroscopy for chemical analysis, differential scanning calorimetry, X-ray diffraction, capillary rheometer, and Instron material testing system were used to characterize the structures and evaluate the properties of HDPE. The results showed that mechanochemical degradation of HDPE occurred under the stress fields of pan-mill, the molecular weight of HDPE was reduced, and HDPE with higher initial molecular weights were easier to degrade under the stress fields. Oxygen-containing groups such as COOH, C=O, and C-O were introduced to HDPE chains as a result of degradation during milling. Crystallinity of HDPE first decreased slightly followed by gradual increases with increasing milling times; monoclinic crystals appeared after four cycles of milling and increased markedly with increasing milling times. Pressure oscillation in capillary flow occurred at significantly higher shear stress and shear rate for milled HDPE than unmilled HDPE. After milling, mechanical properties were improved.

[4] SOLID-PHASE GRAFTING OF HYDROXYMETHYL ACRYLAMIDE ONTO POLYPROPYLENE THROUGH PAN MILLING

Liu CS. Wang Q. - Journal of Applied Polymer Science. 78(12):2191-2197, 2000

The solid-phase graft polymerization of hydroxymethyl acrylamide (HMA) onto polypropylene (PP) was realized by employing our self-designed pan-type milling equipment which has a unique and smart structure and can exert quite strong shear forces and pressure on the materials in between and break them down. When PP particles and HMA are pan-milled together, the macromolecular radicals generated from the chain scission of PP under stress can initiate HMA to polymerize, forming the PP-g-HMA graft copolymer. The graft copolymers were characterized by chemical titration, FTIR, DSC, and contact angle measurement. The amount of grafted HMA depends on the HMA concentration, increase of the PP particles' surface area during pan milling, temperature, as well as rotation speed of the mill pan. The percentage of grafting reaches 2.43%. The particle-size analysis showed that PP with a larger particle size favors the graft polymerization of HMA onto PP. DSC analysis demonstrated that the crystallinity of PP-g-HMA decreases as compared with PP due to the grafting of HMA onto PP.

[3] MECHANICAL RESPONSE AND MODELING OF FULLY COMPACTED NANOCRYSTALLINE IRON AND COPPER

Khan AS. Zhang HY. Takacs L. - International Journal of Plasticity. 16(12):1459-1476, 2000

A comprehensive study on the response of nanocrystalline iron and copper to quasi-static and dynamic loading is reported. Bulk solid nanocrystalline iron and copper specimens used in static and dynamic loading experiments were made by compaction and hot sintering of the nanocrystalline powders. The powders, with grain size 16-96 nm, were obtained by using high energy ball milling. The stress/strain response of dense nanocrystalline iron is found to be grain size and strain rate dependent. The KHL model is modified by incorporating Hall-Fetch relation (i.e. yield stress dependence on grain size) and is used to represent the behavior of fully compacted nanocrystalline material. A good correlation with the experimental results is demonstrated.

[2] MECHANICAL ACTIVATION OF COAL

Welham NJ. Chapman PG. - Fuel Processing Technology. 68(1):75-82, 2000

[1] OPTIMUM CONTROL OF THE LEEUDOORN SEMI-AUTOGENOUS MILLING CIRCUIT

van Dyk W. Stange W. Derbyshire J. Williams H. - CIM Bulletin. 93(1043):106-110, 2000

Intelligent control techniques, such as fuzzy logic, have been successfully applied to the control of a semi-autogenous (SAG) grinding circuit at the Leeuwarden Gold Mine. Benchmarking showed that circuit performance was enhanced by the control system. Benefits included a significantly more stable circuit, improved power efficiency, a reduction in the amount of steel grinding media required, as well as more consistent throughput. A software system, Grind-ACE, based on the intelligent autonomous agent-blackboard paradigm, was developed as an implementation platform. This approach has proved successful and flexible, allowing both intelligent and traditional control techniques to be integrated. The control system has been implemented in a unique manner with both stabilizing and optimizing capabilities, which has resulted in a flexible and adaptable system.

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JRFM'2001 (Programme Provisoire)

Conférences Invitées

1) E. Gaffet

Mécanosynthèse et Activation Mécanique"

CNRS UMR 5060 Université de Technologie de Belfort Montbeliard (UTBM) - 90010 Belfort Cedex

2) M. Boudina

synthèse réactive des matériaux pour des applications aéronautiques à base de Ti-Al-Nb en utilisant de l'hydrogène.

3) Fumio Saito

Title: Mechanochemical Dissociation of HBB

Authors: Qiwu Zhang, Hiroki Matsumoto, Fumio Saito and Michel Baron*

Affiliations: IAMP, Tohoku University (Japan), *Ecole des Mines d'Albi (France)

Conférences orales

11) J. Focf, A. Legris, R.S. de Figueiredo

"Expériences virtuelles de mécanosynthèse : quand la simulation dévoile ce que les examens réels cachent"

Laboratoire de Métallurgie Physique et Génie des Matériaux - (L.M.P.G.M.) - UMR CNRS 8517 / Université des Sciences et Technologies de Lille

10) S. Galdeano*, M-H. Mathon*, L. Chaffron** et C-H. de Novion*

"Etude des corrélations entre les conditions de broyage et la nanostructure dans le composé magnéto-résistif Cu₈₀(Fe_{0.3}Co_{0.7})₂₀"

*Laboratoire Léon Brillouin (CEA/CNRS), CEN Saclay, 91191 Gif-sur-Yvette

** DTA/DECM/SRMP, CEN Saclay, 91191 Gif-sur-Yvette

9) Sylvie Begin-Colin, T. Girot, G. Le Caër, F. Radjai, X. Devaux

"Mécanismes et modélisation de transformations de phase induites par broyage dans TiO₂"

Laboratoire de Science et Génie des Matériaux Métalliques

Ecole des Mines - 54 042 Nancy Cedex

8) J.M. Le Breton, G. Khelifati, L. Aymard et J. Teillet

"Broyage réactif sous hydrogène d'alliages Nd-Fe-B : destruction et recombinaison de la phase Nd₂Fe₁₄B"

Laboratoire de Magnétisme et Applications, Groupe de Physique des Matériaux

UMR CNRS 6634 Faculté des Sciences de Rouen

76821 Mont St Aignan Cedex

7) A. Fnidicki, C. Lemoine, J. Teillet

Effets de la contamination en oxygène et en azote gazeux sur les propriétés structurales et magnétiques des alliages Fe-Cr obtenus par mécanosynthèse.

Magnétisme et Applications - UMR 6634 CNRS

Université de Rouen - 76521 Mont Saint Aignan Cédex

6) B. Chevalier, J-L. Bobet et J. Etourneau

Influence du broyage énergétique sur les propriétés magnétiques d'intermétalliques à base de gadolinium et de manganèse

B. Chevalier, J-L. Bobet et J. Etourneau.

ICMCB - CNRS [UPR 9048]

Groupe IV : Matériaux Magnétiques et Déterminations Structurales

Université Bordeaux I - Avenue du Dr. A. Schweitzer - 33608 Pessac (France)

5) Sophie Soiron, Cyrille Lenain, Luc Aymard, F. Chevallier

Graphite broyé sous hydrogène ou sous oxygène: propriétés électrochimiques

4) Michel Baron, Alain Chamayou et Alexandre GIL

Centre Poudres et Procédés - Ecole des Mines d'Albi Carmaux

Campus Jarlard - Route de Teillet - 81013 ALBI CT Cedex 09

3) G. Saint-Ayès, L. Chaffron, G. LeCaër, G. Martin, J. Viet, G. André

"Usure des roues de TGV : une approche de type alliage forcé"

SRMP/DECM / Bât. 520

CEA Saclay

91191 Gif-sur-Yvette Cedex, France

2) Raphaël Janot et Daniel Guérard

sur la synthèse de nanoparticules de maghémite par broyage mécanique

1) E. Gaffet

"Nanomateriaux : Aspects Technico - Economiques"

CNRS - Groupe "Nanomateriaux"

Université de Technologie de Belfort Montbeliard (UTBM)

Posters

G. Bertrand, C. Meunier, S. Vives, E. Gaffet

Activation Mécanique de Précurseurs pour la Projection Thermique

(UTBM, CNRS, CREST/UFC)

Raphaël JANOT et Daniel Guérard

La préparation, par mécanosynthèse d'hydrures de rubidium et de césium

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Technical Announcement

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