

RESEAU FRANÇAIS DE MECANOSYNTHESE

Lettre N° 55

Octobre 1999

160 (+5) Groupes de Recherche
(dont 88 (+5) à l'étranger / 34 Pays)

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

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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.

JRFM'2000

5^{èmes} Journées du Réseau Français de Mécanosynthèse
23 et 24 Mai 2000 - Bordeaux, ICMCB

Thématique retenue

Caractérisations physico-chimiques des matériaux élaborés par mécanosynthèse

Conférences Invitées

- **Vers la Modélisation de la Mécanosynthèse**
Prof. Jacques FOCT, Université de LILLE

- **Elaboration et caractérisation de nanotubes élaborés par mécanosynthèse**
Dr Laurent CHAFFRON, CEA saclay-CEREM-SRMP/DTM, Gif sur Yvette

- **La Mécanosynthèse au Japon**
Prof. Associé Shin-Ichi ORIMO, Higashi Hiroshima University
Prof. Associé Koichi TSUCHIYA1, Toyohashi university
Prof. Etsuo AKIBA1, NIMC

Contacts et pre - inscriptions

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Réseau Français de Mécanosynthèse

Dr. Eric Gaffet (Pdt of the RFM)
CNRS UPR 806 - Groupe "Nanomateriaux"
Université de Technologie de Belfort - Montbéliard - Site de Sévenans
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ANNONCE DE CONGRES ET / OU ECOLES
CONGRESS AND SCHOOL ANNOUNCEMENTS

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FINE, ULTRAFINE AND NANO POWDERS '99

New Technologies Emerging Applications New Markets
October 17-20, 1999

NOUVEAU

Voir annonce spécifique ci - dessous

Int. Symp. Cluster and Nanostructure Interfaces (ISCANI)

25 - 29 Octobre 1999 - Richmond USA
website : <http://www.vcu.edu/ISCANI/>

Processing and Properties of Structural Nanomaterials
TMS Fall Meeting

31 Octobre - 4 Novembre 1999 - Cincinnati - OH - USA
Contact LL Shaw : fax : 703 6960934

J.A. 99 / SF2M

2- 5 Novembre 1999 - ENSAM / Paris - France
Les matériaux pour les microactionneurs et microcapteurs
Les mécanismes de renforcement dans les polymères & élastomères
Matériaux Magnétiques de Grande Diffusion
Tribologie, Contact Métal - Outil lubrifiant en laminage à froid
Surface et Interface Métallique
Surface et Revêtement
Solidification
Les Imageries de l'angstrom au micron
Les Matériaux pour le Bâtiment
Adresse : SF2M - 1 Rue de Craiova - 92024 Nanterre Cedex

EURO PM99

3rd European Conference on Advances in Hard Materials Production
8 - 10 Novembre 1999 - Turin - Italie
Web site : <http://www.epma.cm>

MRS Fall Meeting 99

29 Novembre - 3 Décembre 1999 - Boston MA - USA
Website : <http://www.mrs.org>

PROCESSING AND CATALYTIC/CHEMICAL PROPERTIES
OF NANOSTRUCTURED MATERIALS

January 16-21, 2000
Maui, Hawaii

NOUVEAU

Voir annonce spécifique ci - dessous

Sintering 2000

7th International Conference on Sintering
Sintering Science and Technology beyond 2000AD
22 - 25 Février 2000 - New Delhi - Inde
E-Mail : gsu@iitk.ac.in

Ultrafine Grained Materials

Strengthening, Fracture and Creep of Nanostructured Materials Symposia
12 - 16 Mars - TMS Annual Meeting - Nashville TN - USA
Contact : RSMIOSHRA@ucdavis.edu

Nanomatériaux :
Vers les Applications Industrielles
Nanomaterials :
Towards Engineering Applications

Colloque : France - Etats Unis - Canada
17-19 Mai 2000 - Montréal, Canada

NOUVEAU

Voir annonce spécifique ci - dessous

JRFM'2000

23 - 24 Mai 2000 - Bordeaux France
Website : <http://www.bls.fr/amatech>

III European Conference on Fluidization

29 - 31 Mai 2000 - Toulouse - France
E-Mail : Progep@ensigct.fr

NOUVEAU

PM2 TEC2000
**2000 International Conference on Powder Metallurgy &
Particulate Materials**
31 Mai - 3 Juin 2000 - New York - USA
Contact : MPIF

4th EUROMECH
26 - 30 Juin 2000 - Metz - France
E-Mail : euromech@lpmm.univ-metz.fr
WebSite : <http://www.lpmm.univ-metz.fr/euromech>

NOUVEAU

ISMANAM 2000
International Symposium on Metastable Mechanically Alloyed and
Nanocrystalline Materials
9 - 14 Juillet 2000 - St Catherines College - Oxford UK
E-Mail :
ismanam2000@materials.ox.ac.uk
website :
<http://www.materials.ox.ac.uk/Conferences.ISMANAM2000.html>

XIVth International Symposium on the Reactivity of Solids

Budapest, Hungary through 27-31 August 2000
<http://www.jate.u-szeged.hu/~isrs14>.

Solid State Chemistry 2000

Prague, Czech Republic, September 3 - 8,2000

(Information provided by Klara Tkacova)

The Institute of Anorganic Chemistry of the Czech Academy of Sciences prepares a conference entitled Solid State Chemistry 2000, which will be held in Prague, Czech Republic, in September 2000.

The meeting will continue the tradition established by the previous SSC conferences which took place in 1986 and 1989 in the Czech Republic, and in 1996 in the Slovak Republic, as well as the tradition of the 1st International Conference on Mechanochemistry and Mechanical Alloying held in 1993 in Kosice, Slovakia. In case of adequate number of presentations and participants would the scientific meeting take place as a satellite symposium entitled **3rd International Conference on Mechanochemistry and Mechanical Alloying INCOME**.

With small number of participants our topic would be discussed in a special section entitled Mechanochemistry.

and
3rd INCOME

International Conference on Mechanochemistry and Mechanical Alloying

Prague, Czech Republic, September 4 - 8,2000

Organised by the Institute of Inorganic Chemistry (UACH), Czech Republic

WebSite : <http://www.iic.cas.cz/INCOME.htm>

NOUVEAU

PM 2000
Powder Metallurgy World
Congress & Exhibition
12 - 16 Novembre 2000 Kyoto - Japon
Contact : Fax : 81 - 3 - 3423 - 1600

NOUVEAU

PM2 TEC2001
2001 International Conference on Powder Metallurgy
& Particulate Materials
13 - 17 May 2001 - New Orleans - USA
Contact : MPIF

Nanomatériaux : Vers les Applications Industrielles Nanomaterials Towards Engineering Applications

Colloque : France - Etats Unis - Canada
17-19 Mai 2000 - Montréal, Canada

Reponsables :

France : Yannick Champion,
Centre d'Etudes de Chimie Métallurgique Vitry-sur-Seine, France.
Canada : Michel Trudeau,
Hydro-Quebec, Technologies Emergentes - Varenne, Quebec, Canada
Etats Unis: Richard Siegel,
Rensselaer Polytechnic Institute Troy, USA

Comité d'organisation :

Eric Gaffet (CNRS / Université de Technologie de Belfort -Montbéliard (UTBM) - France
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Alain Thorel (ENSMP, Evry) - France
Alain Morau - (Innovation 128, Paris) - France

Comité scientifique :

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Daniel Michel (CNRS - CECM, Vitry - France)
Robert Shull (NIST - USA)
Richard Siegel, (Rensselaer Polytechnic Institute Troy, USA)
Gareth Thomas (Univ. California, Berkeley - USA)
Michel Trudeau (Hydro-Québec, Varenne, Canada)
R. Varin (University of Waterloo - Canada)

Objet / Purpose

Le but général de cet atelier est d'initier des projets de recherches en collaborations, entre des industriels et des laboratoires de recherches académiques français et nord-américains, sur des développement technologiques et de nouvelles applications dans le domaine des nanomatériaux.

Les thèmes choisis font ressortir les aspects importants de la fabrication d'architectures nanométriques complexes contrôlant les propriétés de l'objet final : synthèse de poudre, transformation vers le matériau, manufacturing, caractérisation et propriétés. Des exposés seront donnés par des spécialistes dans le domaine, sur les thèmes de la recherche et des développement actuelles, la synthèse, les procédés de transformation et sur les propriétés originales et versatiles des nanomatériaux. Un effort de pédagogie sera demandé pour que ces exposés soient accessibles à tous quel que soit son domaine d'expertise et permettre ainsi des interactions pluridisciplinaires. Les industriels seront invités à présenter les utilisations actuelles et celles qu'ils envisagent pour les nanomatériaux en insistant sur les développement en cours et les verrous limitant les applications.

Contacts:

Dr. Yannick Champion

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Dr. Eric Gaffet

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FINE, ULTRAFINE AND NANO POWDERS '99

New Technologies Emerging Applications New Markets

October 17-20, 1999

Hyatt Orlando (near Walt Disney World® Resort), Orlando (Kissimmee) FL,
USA Tel.: 407/396-1234 (for room reservations)

Trends toward smaller particle sizes in many industries. Ultrafine and nano particle processing issues Current and potential applications and market opportunities Emerging powder needs of customers and end users.

Meet with Technology and Industry Leaders from
Advanced Powder Technology, Australia
Ames Laboratory,
Iowa State University
AP Materials, Inc.
Business Communications Co., Inc.
CAMP,
Clarkson University
Cabot Corp.
COTY Manufacturing UK
DuPont Photopolymer & Electronic Materials
Eastman Kodak Co.
GE Corporate R&D
IAP Research Inc.
IBM T.J. Watson Research Center
Inframat Corp.
Intl. Solar Electric Technology (ISET)
KEMET Electronics
Nanophase Technologies
Nissan Chemical Industrials Ltd. (Japan)
Sandia National Laboratories
Tosoh SMD Inc.
TOTO Ltd. (Japan)
University of California, Berkeley
University of Florida,
NSF Eng. Research Center for Particle Science & Technology
Utron Corp.
Xerox Research Center Europe

Two Workshops on October 17

Workshop I (1:00-5:30 pm) - Production of Functional Particles and Coatings - Current Status and Emerging Trends by Professors Brij Mohan Moudgil and Rajiv Singh, Engineering Research Center for Particle Science and Technology, University of Florida, Gainesville, Florida and Coating of Fine Particles: Methods and Industrial Applications by Professor Richard Partch, Center for Advanced Materials Processing, Clarkson University, Potsdam, New York.

Workshop II (2:00-5:30 pm) - Polymer Nanocomposites - Emerging Scientific and Commercial Opportunities by Professor Emmanuel Giannelis, Materials Science and Engineering Dept., Cornell University, Cornell, New York.

October 20th 1999 - Field Trip to NSF Engineering Research Center (ERC) for Particle Science and Technology, University of Florida, Gainesville, Florida. The trip will provide highlights of research programs at ERC and a tour of the facilities.

Program Chairmen

Dr. Mindy Rittner - E-mail: mruttner@megsinet.net

Dr. Thomas Abraham - E-mail: tombcc@aol.com

Advanced Materials Group, Business Communications Co., Inc.

Register now by phone: 203/853-4266 or fax: 203/853-0348 or by e-mail: conference@buscom.com.

Visit our BCC homepage : <http://www.buscom.com/nanoconference.html>

PROCESSING AND CATALYTIC/CHEMICAL PROPERTIES OF NANOSTRUCTURED MATERIALS

January 16-21, 2000
Maui, Hawaii

The United Engineering Foundation is sponsoring an international conference on PROCESSING AND CATALYTIC/CHEMICAL PROPERTIES OF NANOSTRUCTURED MATERIALS at the Royal Lahaina Resort and Conference Center. The conference co-chairs are Michel L. Trudeau (Hydro-Quebec Research Institute, Canada), Jackie Y. Ying (Massachusetts Institute of Technology, USA) and Virgil Provenzano (Naval Research Laboratory, USA).

Conference Overview

It is clear that of the fields which compose the current "Nanotechnology Revolution", two areas that offer tremendous technological potential are the chemical processing and the surface reactivity of nanostructured materials and, in particular, in relation to catalytic applications. In fact, catalysis has employed ultrafine materials for at least fifty years. Recently, significant developments have been made in new chemical synthesis methods and improved characterization techniques for nanostructured materials, offering the possibility of designing features for reactive materials on the nanometer scale. The research advances of various groups in the past few years have clearly shown that nanostructure design can substantially improve the surface characteristics of materials, as well as offering new insights into the structure-sensitivity of chemical reactions.

In view of the great interest in nanostructured materials and the importance of catalytic materials to industrial processes, it is timely to have a conference that will bring together international researchers from academia and industry to present the state-of-the-art in the fields of chemical processing and catalytic properties of nanostructured materials and to discuss future research directions.

Topics of Interest Include

Novel chemical synthesis of nanostructured materials, such as self-assembly, supramolecular templating, emulsion-assisted synthesis, matrix-mediated synthesis, and electrochemical etching/deposition. Chemical characteristics of nanostructured materials in catalysis and electrocatalysis, gas adsorption, membrane separation, batteries, biochemical processes, and bioinformatics. Processing, surface modifications and applications of nanocrystalline and nanoporous materials, as well as nanocomposites, in catalytic and chemically reactive systems.

Relationships between synthesis, processing, surface reactivity, microstructure and chemical properties of nanostructured materials. Conference Objective

The intent of this conference is to bring together researchers, development engineers and industrial participants with common interests in this important area of technology in order to present and discuss the scientific and technological progress and outline future research and development directions in the area of processing and catalytic/chemical properties of nanostructured materials.

Conference Chairs

Dr. Michel L. Trudeau, Emerging Technologies, Hydro-Quebec, 1800 Boul. Lionel-Boulet, Varennes, Quebec, Canada, J3X 1S1 (Tel: 1-450-652-8265 - Fax: 1-450-652-8905 - E-mail: TRUDEAU.MICHEL@IREQ.CA)

Prof. Jackie Y. Ying, Dept. of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, USA (Tel: 1-617-253-2899 - Fax: 1-617-258-5766 - E-mail: JYYING@MIT.EDU)

Dr. Virgil Provenzano, Materials Science and Technology Division, Naval Research Laboratory, Code 6323, Washington, DC 20375-5000 (Tel: 1-202-767-2565 - Fax: 1-202-767-4470 - E-mail: PROVENZANO@ANVIL.NRL.NAVY.MIL)

Conference Attendance

The format of this conference is chosen to encourage many opportunities for detailed discussions and interactions among participants. In order to preserve this atmosphere, attendance will be limited and will be by invitation only. Persons wishing to attend the conference should submit an application (form to be faxed or mailed) (on-line form to be e-mailed) as soon as possible, but not later than October 1, 1999.

Conference Format

The format of the conference is similar to that used in previous Engineering Foundation meetings in which blocks of time are allocated for informal exchange of ideas among participants. For example, time will be set aside for this purpose in the early afternoon and late evening. There will be a sizable and comprehensive poster session with posters made available for viewing throughout the conference period.

United Engineering Foundation Conferences Fellowship Program The United Engineering Foundation sponsors a Conference Fellowship Program. Applicants are limited to those currently active in engineering or related professions with a direct interest in the conference topic. They must be within ten years of their B.Sc. degree at the time their applications are submitted. The stipend is sufficient to cover the conference registration fee and on-site room and board. Transportation expenses are not included. Typically one Fellowship per conference is awarded. Application information may be obtained from the WWW or by fax from the Foundation (1-212-591-7441) and must be submitted by October 1, 1999.

For further information, please contact:

United Engineering Foundation
Three Park Avenue, 27th Floor - New York, NY 10016-5902
T: 1-212-591-7836 F: 1-212-591-7441 - E-mail: engfnd@aol.com Website: www.engfnd.org

SOUTENANCE DE THESE

Olivier Held

"Etude des réactions de combustions solide-solide ou solide liquide auto-entretenues pour différents intermétalliques du système Al-Ni-Ti.

Elaboration de ces mêmes intermétalliques par broyage mécanique et étude de leur cinétique de cristallisation
Nancy, Faculté des Sciences, le 5/11/99.

Jury : J. L. Jorda, J. M. Moreau, P. Satre, J. C. Gachon, F. A. Kuhnast, F. Bernard, J. F. Bézar, M. Bessière.

Le travail de thèse consiste à déterminer les chemins de réaction qui mènent aux composés intermétalliques en partant, soit des métaux purs, soit d'alliages amorphes préparés par broyage au broyeur planétaire. Quand on part :

- 1) des métaux purs, le composé est formé par autocombustion,
- 2) d'un amorphe, le composé est obtenu par cristallisation.

Les techniques de contrôle sont classiques pour les alliages métalliques (RX, microsonde) tandis que celles spécifiques à l'étude sont la calorimétrie différentielle à balayage et la diffraction des rayons X en temps réel au LURE à Orsay.

Les résultats obtenus par les deux voies sont décrits, analysés et comparés. L'influence du dopage de binaires par un tiers élément est étudiée à propos de deux cas : AlTi₃ et NiTi.

D. Cracco

"Recherche de Nouveaux Alliages Hydrurables de Forte Capacité Massique Utilisable comme Matériaux d'Electrode Négative d'Accumulateur Ni - MH"
CNRS - Thiais - France - 25 Juin 1999

Jury : B. Darriet, L. Schlapbach, B. Knosp, R. Portier, A. Percheron - Guégan

A. Gentil - Sagot

Amélioration de la tenue au fluage d'un alliage d'argent (AIC) par introduction d'une dispersion d'oxydes.
Elaboration par Métallurgie des Poudres

Ecole des Mines - Paris - 17 Juin 1999

Jury : M. Grosbras, L. Charrin, S. Kleine, D. Havart, J. - L. Strudel, Y. Bienvenu

Cooperative Research on Related Areas

COREE du SUD (6 May 1999)

From Professor Soon B. Hong
Department of Materials Science and Engineering
Korea Advanced Institute of Science and Technology
373 - 1 Kusung - dong, Yusung - gu
Taejon 305 - 701 Korea

One research topic is entitled "Mechanical Behavior and Wear Resistance of Nanocrystalline WC - Co alloy". We are investigating the fabrication process, sintering and mechanical & wear properties of nanocrystalline WC - Co hard materials. The other research topic is titled "Fabrication Process and Mechanical Properties of Mechanically Alloyed Tungsten Heavy Alloys". We are investigating the mechanical alloying process, sintering behavior and mechanical properties of MA tungsten heavy alloys.

We are very pleased to discuss for international cooperative research on above research topics with Member of Mecanosynthese Group

E-Mail : ShHong@Sorak.kaist.ac.kr

**Ph D Position and
Post Doc Position
Requests - Proposals**

***** Looking for Job Position (6th July 1999)**

I have a Ph.D. in Physics (Mechanical Alloying by Ball Milling) from the Australian National University (Canberra) and extensive experience (more than 17 years and more than 40 publications) in the area of Materials Sciences, Mechanical Engineering and Electronics. The topic of my Ph.D. was Production of Hard Materials by Mechanical Alloying (under the guidance of Dr. A. Calka). I have worked on the production of hard compounds by ball milling such as nitrides, carbides and special alloys. I have completed a post-doctoral fellowship program in Japan (Tokyo University of Technology and The Photon Factory at Tsukuba) and I am currently working as a X-ray Diffraction Officer at CSIRO in Melbourne (Australia). My contract expires and I am looking for a new position.

For more information please contact: ph./fax +61-3-95433002 or email: Jonian.Nikolov@Minerals.CSIRO.au

****** Proposals**

FRANCE (2/07/99)

Joindre Pascal Viel , tél 01 69 08 41 47 CEA SRSIM Bt 461, 91191 Gif sur yvette

Proposition de post doc qui débiterait idéalement en septembre 99. Le financement du post doc est acquis (1 an) Le lieu de travail est le centre de Saclay (DSM/DRECAM/SRSIM) Le sujet concerne une étude très appliquée sur la dépollution des eaux de rejets industriels : Mise au point et étude d'un procédé d'élimination des métaux lourds basé sur la fabrication d'un filtre actif (complexation-décomplexation) utilisant la modification de surfaces métalliques par des films polymères électrogressés en couches minces.

Conditions: avoir sa thèse depuis moins d'un an, ne pas avoir été salarié depuis sauf pour un an de postdoc à l'étranger et avoir moins de 30 ans

FRANCE (6/06/99)

P. Bracconi (Univ. Dijon) propose une position de Post Doc en Métallurgie des Poudres, de nationalité autre que française (Poste Fléché CNRS)

Contact : pbrac@u-bourgogne.fr

GRECE (11/06/99)

The PEML (Photonics and Electronics Materials Lab) at FORTH, Herklion Crete, Greece, offers two positions available for European Post and Pre Docs, to work within the framework of two TMR networks (HAFAM and MICROSYNC) concerning microfabrication and microassembling"

Contact : Porf. G. Kiriakidis : Kiriakid@iesl.forth.gr

ISRAËL (14/5/99)

A postdoctoral position is available at the High-Pressure group of the School of Physics & Astronomy, Tel Aviv University. This position is available starting with the 1999/2000 academic year for one year, with a possible extension for two years. For additional information, please contact Moshe P. Pasternak by email to hh136@post.tau.ac.il or visit the MEDC web site (www.unca.edu/medc).

Denmark (22/02/99)

One Ph.D. position will be available in the department of Physics at the Technical University of Denmark from 1st April 1999. The candidate will work in the area of Crystallization Kinetics in Bulk Metallic Glasses, which is associated with a Talent Project supported by the Danish Research Council. The position is for three years, and monthly salary is about 20,000 DKr (3300 USD). Applications including a CV, publication list, and names of three references should be sent as soon as possible to:

Assoc. Prof. Jianzhong Jiang
Department of Physics, Building 307
Technical University of Denmark
DK-2800 Lyngby, Denmark
e-mail jiang@fysik.dtu.dk
fax. +45 45 93 23 99
tel +45 45 25 31 65

Québec (CANADA) (22/01/99)

Institut National de la Recherche Scientifique
Département ...nergie et Matériaux

POST-DOCTORAL POSITION IN Ni-MH BATTERY TECHNOLOGY

Candidates will be interested in developing a research project focused on the study of new materials for use as negative electrode in nickel-metal hydride (Ni-MH) batteries. Mg-based compounds as electrode material and high-energy ball milling as synthesize method will be privileged. Particular efforts will be performed in order to clarify the correlation between the structure, the composition and the morphology of the alloy and its electrochemical performances.

Experience in electrochemistry and materials science is essential, a working knowledge of Ni-MH battery is an advantage.

Applicants must have obtained their Ph-D between July first, 1996 and January first, 2000.

The work will start between June 1st, 1999 and May 31, 2000.

Initial appointment is for one year, renewable for one year. Salary is \$28,000/year, which could be increased with qualifications and experience.

Applicants should send a CV including a list of publications before March 1st, 1999 to:

Pr. Lionel ROUE
INRS- Energie et Matériaux
1650, bd. Lionel Boulet
Varenes, Québec, CANADA
J3X 1S2
E-Mail: HYPERLINK mailto:roue@inrs-ener.quebec.ca / roue@inrs-ener.quebec.ca

USA (17/12/98)

Rutgers University is seeking a postdoctoral associate with demonstrated expertise in mechanochemistry to work on research focused on biomaterials. The candidate must be able to work on research focused on biomaterials. The candidate must be able to work as part of multidisciplinary team involving industry and academia focused on making biomedical implant devices. 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, address, 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 will be posted until a suitable candidate is identified. Interested candidates should send correspondence to

Professor R.E. Riman

Rutgers University Department of Ceramic and Materials Engineering

607 Taylor Road Piscataway, NJ 08854 - 8065

Riman@alumina.rutgers.edu

Bibliographie Récente

Livres ou "Special Issues"

"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 : 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.ttp.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 Besterci, 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

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)

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"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 nanométrie) ; 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'angströms, 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)

PERIODIQUES

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

[58] "TEXTURE AND MICROSTRUCTURE IN MECHANICALLY ALLOYED AND EXTRUDED AL-AL3TI ALLOYS"

T. GROSDIDIER, S. LENHARD, K. HELMING, C.P. CHANG and F. WAGNER,
ICOTOM 12 (International Conference on Texture of Materials), Montréal - Canada, Édité par J.A. Szipunar, NRC Research Press, Ottawa, Vol. 1, p. 797 - 802, 1999

[57] "TEXTURE AND MICROSTRUCTURE DEVELOPMENT DURING PROCESSING OF UFG COPPER BY EQUAL-CHANNEL ANGULAR EXTRUSION"

A. TIDU, F. WAGNER, W.H. HUANG, P.W. KAO, C.P. CHANG and T. GROSDIDIER
ICOTOM 12 (International Conference on Texture of Materials), Montréal - Canada, Édité par J.A. Szipunar, NRC Research Press, Ottawa, Vol. 1, p. 694 - 699, 1999

[56] "TEXTURE / MICROSTRUCTURE AND PROPERTIES IN FEAL ALLOYS PROCESSED BY MECHANICAL ALLOYING AND EXTRUSION"

S. LENHARD, F. WAGNER, S. REVOL, R. BACCINO and T. GROSDIDIER
ICOTOM 12 (International Conference on Texture of Materials), Montréal - Canada, Édité par J.A. Szipunar, NRC Research Press, Ottawa, Vol. 1, p. 683 - 688, 1999

[55] CRITICAL ROTATION SPEED FOR BALL-MILLING

Watanabe H. - Powder Technology. 104(1):95-99, 1999

Critical rotation speed of dry ball-mill was studied by experiments and by numerical simulation using Discrete Element Method (DEM). The results carried out by both methods showed good agreement. It has been commonly accepted that the critical rotation speed is a function of a ball radius and a jar diameter. The results of the present work, however, show that the critical rotation speed significantly depends on ball-containing fraction in jars, and approaches a value asymptotically as the ball-containing fraction approaches to one. This asymptotic value is equal to the traditional critical rotation speed. The effect of individual rotation of the ball of the jar is significantly small to centrifugal motion.

[54] INFLUENCE OF EXTRUSION RATIO AND TEMPERATURE ON MICROSTRUCTURE AND MECHANICAL PROPERTIES OF 2024 ALUMINIUM ALLOY CONSOLIDATED FROM NANOCRYSTALLINE ALLOY POWDERS VIA HOT HYDROSTATIC EXTRUSION

Hu L. Li Z. Wang E. - Powder Metallurgy. 42(2):153-156, 1999.

Nanocrystalline 2024 aluminium alloy powders with an average grain size less than 50 nm, prepared by a unique technique which combines rapid solidification and mechanical milling, were consolidated into bulk material under various technical conditions via hot hydrostatic extrusion and the microstructure and mechanical properties of the consolidated alloy were experimentally investigated. The influence of the two main technical parameters, extrusion ratio and temperature, on the microstructure and mechanical properties of the as extruded alloy is made clear and the reasons why these two parameters had such an influence on the microstructure and mechanical properties of the alloy are also discussed. Furthermore, suggestions are given for rationalising the extrusion ratio and temperature for the consolidation of the nanocrystalline 2024 aluminium alloy powders via hot hydrostatic extrusion.

[53] MECHANOMAKING OF NANOSTRUCTURED HYPEREUTECTIC WHITE IRONS: POWDER FABRICATION

Matteazzi P. Wolf F. - Materials Science & Technology. 15(7):779-790, 1999

White irons containing 5.7 wt-%C were produced by room temperature, high energy milling from iron and carbon elemental powders. Both iron and cementite phases have crystal sizes of less than 10 nm in the powders which have fully dense particles of 50 μm mean size. The gas content is 0.5 wt-% and the powder is stable up to 550 degrees C. Above 550 degrees C decomposition of cementite occurs, involving a decrease in combined carbon content from 5.7 to 3.5 wt-% (annealing at 1050 degrees C). The crystal growth kinetics has two temperature regions with lower activation energies in the high temperature (above 800 degrees C) region. Crystal sizes still below 100 nm were observed for annealing up to 800 degrees C. The size distribution in mechanosynthesised powders was modified by tumbling (dry) and attritor (wet) milling down to mean sizes of 4 μm and 1.4 μm respectively. Whereas tumbling milling does not alter the properties of MS powders, wet attritor milling produced higher gas content (7 wt-%) and much decreased thermal stability. Mechanosynthesised and tumbling milled powders can be degassed prior to consolidation, while wet attritor milled ones cannot.

[52] MECHANICAL BEHAVIOUR OF A BIMODAL MICROSTRUCTURED POWDER METALLURGY Ni3Al

Perez P. Jimenez JA. Borrego A. Adeva P. - Materials Science & Technology. 15(7):833-839, 1999

The tensile and compressive properties at room temperature of powder metallurgy Ni₃Al synthesised using rapidly solidified powder particles, which were milled for up to 20 h, have been investigated. Furthermore, the mechanical behaviour at high temperatures has been studied by strain rate change tests in compression at strain rates ranging from 5×10^{-6} to 2×10^{-3} s⁻¹ and temperatures from 1073 to 1373 K. For comparative purposes, tensile tests at room temperature were carried out in materials consolidated from particles in both the as rapidly solidified condition (RS) and after 2 h of milling time. Both materials showed a very similar microstructure composed of equiaxed grains. However, an increase in the yield strength of close to 40% was exhibited by the 2 h milled particle material. The intermetallic made of 20 h milled particles presented a bimodal microstructure and showed a dramatic increase in yield strength at room temperature to 740 MPa, more than twice the value reached by the material consolidated with RS particles. The analysis of the stress-strain rate data of tests performed at elevated temperatures revealed a transition from a stress exponent n approximate to 5 to an exponent n approximate to 3.5 at low stresses and/or high temperatures of testing. An activation energy for plastic flow of 370 kJ mol⁻¹ was deduced in the low stress regime.

[51] FERROMAGNETISM AND STRUCTURAL DISTORTIONS INDUCED IN ATOMIZED FE-AL (35-42 AT.% AL)

POWDER PARTICLES BY COLD MILLING

Fujii M. Saito K. Wakayama K. Kawasaki M. Yoshioka T. Isshiki T. Nishio K. Shiojiri M. - Philosophical Magazine A-Physics of Condensed Matter Defects & Mechanical Properties. 79(8):2013-2023, 1999

Micrometre-sized particles of Fe_{1-x}Al_x (x = 0.35-0.42) powder prepared by the atomizing method have been investigated by magnetization measurement and high-resolution transmission electron microscopy. As-atomized particles are paramagnetic and they consist of a few grains of the B2 structure. Cold milling for several hours magnetizes the particles to a spontaneous magnetization as great as 100 emu g⁻¹. The milled particles become flakes composed of lamellae, expanding parallel to the (110) plane and having a heavily distorted lattice. The lamella has a mosaic structure consisting of nanometre-sized grains whose boundaries are frequently antiphase with large numbers of Fe-Fe nearest couplings, which may be at the origin of ferromagnetism in cold-worked powders. When the milled powder is heated for a time as short as 1 min at 100-400 degrees C, the lattice distortion is relaxed by recrystallization of the nano-grains, the lamella being kept, and consequently the magnetization decreases to a few emu g⁻¹.

[50] THE EFFECT OF SILICON ADDITION ON THE MECHANICAL ALLOYING OF FEB POWDER

Hwang Y. Lee HS. Chung HS. Kim TS. Oh SJ. Kwon SJ. - Journal of the Korean Physical Society. 35(Part 2 Suppl S):S236-S240, 1999

FeB powders were prepared by mechanical alloying, and the effect of silicon addition during mechanical alloying on the crystal structure, the phase evolution, and the magnetic properties was investigated by using X-ray diffraction, differential scanning calorimetry, Mossbauer spectroscopy, and vibrating sample magnetometry. The starting elements, Fe and Si, were incorporated into the alpha-Fe structure during mechanical alloying. After annealing the alloyed powder at 800 degrees C in vacuum, two phases, FeB and Fe₂B, were found to coexist. Silicon enhanced the amorphization of the FeB powders and reduced the synthesis time required by mechanical alloying. It was revealed that the formation of the Fe₂B phase could be restricted by substituting a small amount of Si for B.

[49] SURFACE STRUCTURE OF MECHANICALLY ACTIVATED AND OF MECHANOSYNTHESIZED ZINC FERRITE

Druska P. Steinike U. Sepelak V. - Journal of Solid State Chemistry. 146(1):13-21, 1999

Zinc ferrite forms the structure of a normal spinel, A mechanical activation and a mechanosynthesis of zinc ferrite at room temperature lead to the formation of the metastable inverse spinel structure. The changes in the surface structure of mechanically activated and of mechanosynthesized zinc ferrite as a function of the mechanical treatment time and the relaxation of the mechanically induced inverse spinel structure by thermal treatment in the temperature range 800-1100 K have been studied using the ESCA method. The surface structure of the mechanically disturbed zinc ferrite, compared to the bulk structures of the inverse and normal spinels, and the mechanically induced increase in the reactivity are discussed.

[48] STATE OF MANGANESE ATOMS DURING THE MECHANOCHEMICAL SYNTHESIS OF LiMn₂O₄

Kosova NV. Asanov IP. Devyatkina ET. Avvakumov EG. - Journal of Solid State Chemistry. 146(1):184-188, 1999

It has been established using X-ray photoelectron spectroscopy in combination with other physical methods that the initial stages of mechanochemical synthesis of LiMn₂O₄ in mixtures of MnO₂ with LiOH and Li₂CO₃ are considerably different. In the first case the "smearing" of LiOH, having a flaky structure, on the surface of MnO₂ and the formation of an amorphous layer take place. The reaction is accompanied by a redox process, with the participation of OH groups and Mn⁴⁺ ions and with diffusion of lithium ions to the interior of the particles, and is completed by formation of Li-O-Mn bonds. No change in the valence state of manganese was detected, in Li₂CO₃, only brittle fracture was observed. Formation of defect spinel-like Li₂O . yMnO(2) (2.5 less than or equal to y less than or equal to 4) on the surface is proposed.

[47] DECOMPOSITION OF BN AND FORMATION OF Nd₂Fe₁₄BN_x PHASE PREPARED BY MECHANICAL ALLOYING

Liu W. Zhang ZD. Sun XK. He JF. Zhao XG. - Journal of Physics D-Applied Physics. 32(14):1591-1594, 1999

The decomposition of pyrolytic boron nitride (p-BN) during milling is studied as a function of the milling time. It has been found that the p-BN compound can be partially decomposed by milling until an amorphous p-BN phase is formed so that the content of nitrogen in the p-BN system will not continue to be changed by the milling process. Furthermore, the structure and magnetic properties of Nd₂Fe₁₄BN_x-based alloys prepared by mechanical alloying using either p-BN or milled p-BN as starting material have been investigated. The Nd₂Fe₁₄BN_x phase with x up to 0.25 coexists with some amounts of NdN, the Nd-rich phase and alpha-Fe. A pre-milling process of p-BN favours the formation of the Nd₂Fe₁₄BN_x phase. The magnetic properties of Nd₁₆Fe₇₆B₈N_x alloys prepared by using milled p-BN are better than those made of non-milled p-BN. The Curie temperature of the Nd₂Fe₁₄BN_{0.25} phase is 335 degrees C, which is slightly higher than that of the Nd₂Fe₁₄B compound. A coercivity higher than 20 kOe is achieved for Nd₂Fe₁₄BN_x-based alloys by adding excess Nd, which is close to the value of Nd₁₆Fe₇₆B₈ prepared by using pure B.

[46] MECHANO-CHEMICAL WEAR OF CERAMICS

Stolarski TA. - Journal of Materials Science. 34(15):3609-3622, 1999

An experimental study has been carried out to ascertain the role of mechano-chemical effects in accelerated material removal from hard and brittle surfaces such as engineering ceramics. It was established that chemical effects are far more effective in material removal than the mechanical action of abrasive particles alone. Mechanical action is governed by the applied load, amount of relative slip within the contact zone, and the size of abrasive particles. Chemical effects depend mainly on the nature of additives and their ability to react with ceramic surface under contact conditions. Maximum wear rate is achieved when both mechanical action and chemical reactions take place simultaneously.

[45] GRINDING EFFECTS OF HOST CRYSTALS ON FORMATION AND PROPERTIES OF TITANIA PILLARED FLUORINE MICAS

Yamaguchi T. Kuniyoshi F. Kitajima K. - Journal of Materials Science. 34(15):3685-3693, 1999

Fluorine micas having different grinding times were allowed to react with titania sol prepared by hydrolyzing titanium tetraisopropoxide (TTIP) with hydrochloric acid in order to clarify the influence of grinding upon reactivity of synthetic fluorine micas [$M_{0.8}Mg_{2.2}Li_{0.8}(Si_4O_{10})F_2(M = Na, Li)$]. Prolongation of grinding time promoted delamination and fineness of host mica crystals, resulting in increasing specific surface area. The heating weight loss and intensity of IR absorption bands around 1600 and 3400 cm^{-1} also increased with increasing grinding time, indicating the increase in absorbed water on ground mica particles. Properties of titania pillared fluorine micas depended on grinding time of host micas. Specific surface areas and titania contents of pillared fluorine micas increased with increasing grinding time, so that the effect of interlayer cations (Na^+ , Li^+) upon complex formation of titania pillared micas almost diminished. When host mica crystals were larger, the reaction occurred mainly in the interlayer region. However, when host mica crystals were ground to be finer, the reaction on external surfaces of ground particles occurred simultaneously along with intercalation. These results show that mechanochemical effects resulted from grinding have the profound influence on the formation and properties of titania pillared fluorine micas.

[44] EFFECT OF PURE-SOLVENTS WITHOUT DEFLOCCULANTS FOR FINER SiC PARTICLE DISPERSED MgO BASED COMPOSITE

Choa YH. Bamba N. Hayashi H. Kondo H. Sekino T. Niihara K. - Journal of Materials Science. 34(15):3789-3793, 1999

The deagglomeration process and its effects on the microstructure have been investigated for fine MgO, SiC powders and SiC particle added MgO mixed powders which were ball-milled under both polar- and non-polar solvent without deflocculants. During the drying, exothermic reactions are observed at 300-450 degrees C in MgO and SiC powders ball-milled in alcohol. On the other hand, no chemical reaction could be observed for the powders ball-milled using acetone, and n-hexane. The observed exothermic reactions, then, are believed to be due to the oxide and/or oxide layer-alcohol reaction product formed during milling. This mechano-chemical reaction directly affects to deagglomerate during the drying process after wet-milling. Among the alcohol media, the well-dispersibility and deagglomeration of SiC powders as well as MgO powders seem to be reached by n-butyl alcohol, considering the balance between the steric effects and the dielectric constant of alcohol. These dispersion characteristics also effect on the microstructure of SiC particle dispersed MgO based composites.

[43] MAGNETIC PROPERTIES OF NANOSTRUCTURED GAMMA-NI-46FE ALLOY SYNTHESIZED BY A MECHANOCHEMICAL PROCESS

Qin XY. Lee JS. Kim JG. - Journal of Applied Physics. 86(4):2146-2154, 1999

Magnetic properties and their relations to microstructures of nanostructured gamma-Ni-46Fe alloy (nano gamma-Ni-46Fe), synthesized by a mechanochemical process, were investigated at temperatures from similar to 300 down to 8.5 K. The results indicated that the nano gamma-Ni-46Fe with average grain sizes of 20-220 nm displayed ferromagnetism, with no superparamagnetic phenomenon being observed in the temperature range investigated. Coercivity increased with decreasing grain size obeying the law $H(c)$ proportional to $1/d$ well in the grain size regime $d > \text{similar to } 100 \text{ nm}$. Contrary to prediction from the random anisotropy model, however, the coercivity at both 300 and 8.5 K was not found to decrease with further decreasing grain size in the size range $d = 20\text{-}100 \text{ nm}$, although the grain sizes were then obviously smaller than the evaluated value (102 nm) of ferromagnetic exchange length, suggesting random anisotropy did not dominate its magnetic behavior. Instead, it was demonstrated that the further increase of coercivity with decreasing grain size as $d < 100 \text{ nm}$ can be attributed to the effect of shape anisotropy in the nano gamma-Ni-46Fe. Saturation magnetization M_s of the nano gamma-Ni-46Fe was found to decrease with decreasing grain size, with a magnitude of similar to 11% smaller than that of the coarse-grained standard being reached at d approximate to 20 nm. Experiments revealed that this decrease of M_s was closely related to the increase of oxygen content in the specimens, implying oxidation would be responsible for the decrease of M_s . By assuming that the oxygen existed in the form of surface oxidation layers wrapping the nano-grains, a thickness of similar to 0.8 nm for the oxidation layers was derived from the magnitudes of M_s corresponding to different grain sizes.

[42] GRAIN-BOUNDARY MAGNETIC PROPERTIES OF BALL-MILLED NANOCRYSTALLINE FEXRH100-X ALLOYS

Navarro E. Hernando A. Yavari AR. Fiorani D. Rosenberg M. - Journal of Applied Physics. 86(4):2166-2172, 1999
FexRh100-x ($x = 65, 50, 28, \text{ and } 26$) fcc nanocrystalline alloys have been produced using the high-energy ball-milling technique. All the compositions investigated exhibited a maximum in the alternative and zero field cooled susceptibilities in the low temperature regime. The temperature at which this maximum occurs, T_{max} , weakly depends on both the frequency and the applied field, and increases with the grain size. These features suggest the appearance of a spin-glass ground state for all the compositions analyzed. The Mossbauer spectra at $T < T_{\text{max}}$ shows a broad distribution of hyperfine fields similar to that of an amorphous magnet. Shifted hysteresis loops as well as a considerable irreversibility at high fields indicate that T_{max} corresponds to the freezing temperature of the strongly deformed grain boundaries, which behave as spin-glass-like phase.

[41] MICROSTRUCTURE, MECHANICAL PROPERTIES AND OXIDATION BEHAVIOR OF POWDER COMPACTS OF THE Nb-Si-B SYSTEM PREPARED BY SPARK PLASMA SINTERING

Murakami T. Xu CN. Kitahara A. Kawahara M. Takahashi Y. Inui H. Yamaguchi M. - Intermetallics. 7(9):1043-1048, 1999

Powder compacts with eight different compositions in the Nb-Si-B system were prepared by spark plasma sintering and their microstructure, mechanical properties and oxidation behavior were investigated. Oxidation resistance of $Nb_5Si_3B_2$ compacts is better than that of Nb_5Si_3 compacts, but extremely poorer than that of $NbSi_2$, compacts. However, since the oxidation experiment was of short duration, details of the oxidation behavior of Nb-Si-B compacts have yet to be investigated. Compacts were prepared via the following three different routes: (i) elemental powders were mixed in a rotational ball mill and then consolidated by spark plasma sintering method, (ii) elemental powders were mechanically alloyed and consolidated similarly to (i) and (iii) pulverizing compacts prepared via route (i) and consolidated once again similarly to (i). Compacts prepared via the third route exhibit more homogeneous

microstructures and contain a smaller amount of SiO₂ than compacts prepared via the other two routes. Compacts with compositions around the line of Nb₅Si₃-Nb₅Si₃B₂-NbB₂ exhibit a high hardness at room temperature and a high compressive strength at high temperatures in comparison to those with compositions away from the line. The strength of compacts containing NbSi₂ decreases with increasing the volume fraction of NbSi₂ phase.

[40] EFFECTS OF MECHANICAL ACTIVATION ON THE SINTERING AND DIELECTRIC PROPERTIES OF OXIDE-DERIVED PZT

Lee SE. Xue JM. Wan DM. Wang J. - *Acta Materialia*. 47(9):2633-2639, 1999

A single phase, nanocrystalline perovskite PZT powder has been successfully derived from a mixture of oxides via a mechanical activation route. Unlike in the conventional solid state reaction, the perovskite PZT phase was first triggered and then progressively formed without passing through the intermediate PT and PZ phases with increasing degree of mechanical activation. Similarly, the formation of a single phase PZT of perovskite structure can be completed in a partially activated mixture of oxide powders when heated at an elevated temperature, also without involving PT and PZ as transitional phases. Dense PZT (>95% theoretical density) with excellent dielectric properties was obtained when the mechanically activated powders are sintered at 1150 degrees C. The relative density and dielectric properties of sintered PZT were improved when the formation of perovskite phase is completed by the mechanical activation.

[39] DEPENDENCE OF THE STRUCTURAL AND DIELECTRIC PROPERTIES OF Ba_{1-x}Sr_xTiO₃ CERAMIC SOLID SOLUTIONS ON RAW MATERIAL PROCESSING

Zhou LQ. Vilarinho PM. Baptista JL. - *Journal of the European Ceramic Society*. 19(11):2015-2020, 1999

The structures and dielectric properties of Ba_{1-x}Sr_xTiO₃ ceramic solid solutions in the whole x range and their dependence on the material processing are investigated. A short time pre-calcination milling-mixing of the precursor powders causes compositional inhomogeneity and thus a diffuse phase transition. For long milling-mixing time, the diffuse phase transition is observed only in the SrTiO₃ rich compositions (x > 0.8).

[38] THE EFFECTIVE MAGNETIC ANISOTROPY IN NANOCRYSTALLINE Fe_{100-x}Si_x ALLOYS

Zhou TJ. Yu Z. Du YW. - *Journal of Magnetism & Magnetic Materials*. 202(2-3):354-358, 1999

The effective magnetic anisotropy in the nanocrystalline Fe_{100-x}Si_x (x less than or equal to 25) alloys prepared by mechanical alloying was measured using the law of approach to saturation. It is found that the effective magnetic anisotropy constants K_{eff} decrease with increasing Si concentration, and are larger than those of the corresponding polycrystalline Fe_{100-x}Si_x alloys. The Mossbauer patterns showed that the substitution of Si atoms for Fe ones is disordered. The high coercive force found in these alloys may be related to the high stress and doping in grain boundaries.

[37] CHARACTERIZATION OF NANOSTRUCTURED MAGNETIC MATERIALS

Pardavi-Horvath M. - *Journal of Magnetism & Magnetic Materials*. 203(Special Issue SI):57-59, 1999

One of the basic problems of characterizing magnetic nanocomposites is to get information about the statistical distribution of the defects, and shape, and size of the particles. It is desirable to use quick, reliable and inexpensive magnetic methods. Information is usually obtained from the measurements of the DC remanence loop and switching field distribution (SFD), and the application of Preisach type hysteresis models. The discrete Fourier transform of the DC remanence curve is directly related to the SFD, and its application is illustrated on the example of magnetic nanocomposites of Fe particles embedded into a ZnO matrix, prepared by reaction milling.

[36] MAGNETIC INVESTIGATIONS ON THE DISORDERING OF A BALL MILLED Fe-40Al AT% ALLOY

Amils X. Nogues J. Surinach S. Baro MD. - *Journal of Magnetism & Magnetic Materials*. 203(Special Issue SI):129-131, 1999

The disordering process of a B2 Fe-40 Al at % alloy induced by ball milling has been studied from magnetic and structural points of view. The ball milling process involves several steps: loss of long-range order, reduced crystallite size, induced microstrains, loss of short-range order and lattice expansion. These structural changes induce an irreversible transition from a paramagnetic to a ferromagnetic state, which can be observed in the different magnetic parameters studied.

[35] MAGNETISM OF NANOSTRUCTURED MECHANICALLY ACTIVATED AND MECHANOSYNTHESIZED SPINEL FERRITES

Sepelak V. Wissmann S. Becker KD. - *Journal of Magnetism & Magnetic Materials*. 203(Special Issue SI):135-137, 1999

New mechanochemical methods of material synthesis have received increased attention in recent years. The changes in the structure of the mechano-synthesized zinc ferrite (synthesized by the high-energy milling of the ZnO/Fe₂O₃ mixture) and of mechanically activated spinel ferrite (synthesized by the conventional thermal method, followed by mechanical treatment) as a function of the mechanical treatment time have been studied using the Mossbauer spectroscopy and electron microscopy. Attention is concentrated on the explanation and comparison of an origin of mechanically induced changes in magnetic properties of both the nanoscale mechano-synthesized and mechanically activated zinc ferrites.

[34] MAGNETIC PROPERTIES OF ZnFe₂O₄ SYNTHESIZED BY BALL MILLING

Goya GF. Rechenberg HR. - *Journal of Magnetism & Magnetic Materials*. 203(Special Issue SI):141-142, 1999

We present a study of the intermediate and final phases during mechano-synthesis of ZnFe₂O₄. Mossbauer measurements at T = 4.2 K indicate creation of oxygen vacancies and local disorder at Fe sites during milling. Magnetization data show lack of saturation and irreversibility at high fields. Our data is qualitatively well described by a model of particles with a magnetic ordered core coupled to a spin-disordered surface layer.

[33] SYNTHESIS AND CHARACTERISATION OF AMORPHOUS Fe₇₅Zr₂₅ OBTAINED BY BALL MILLING

Pizarro R. Barandiaran JM. Plazaola F. Gutierrez J. - *Journal of Magnetism & Magnetic Materials*. 203(Special Issue SI):143-145, 1999

In this work we report the preparation of amorphous Fe₇₅Zr₂₅ by ball milling from elemental components. For this

concentration, not accessible with other techniques, Curie temperature (T-c) is near the maximum for this binary system. Amorphisation process was followed by X-ray diffraction. Magnetic moment, coercivity and Curie temperature have been measured in a SQUID magnetometer. Mossbauer spectroscopy has been used to determine the fraction of the amorphous phase, and as an alternative way to measure Curie temperature. After 85 h of milling two phases are present: Fe-Zr amorphous alloy and an excess of nanosized crystalline Fe. T-c = 245 +/- 5 K is estimated for this sample, which is consistent with an amorphous composition Fe(70)oZr(30) deduced from the Mossbauer spectra. Differential thermal analysis (DTA) was used to characterise the crystallisation process. Crystallisation products were identified as alpha-Fe and intermetallic Fe₃Zr.

[32] FORMATION AND MAGNETIC PROPERTIES OF MECHANICALLY ALLOYED FE-CU-NB-ZR-B NANOCRYSTALLINE POWDERS

Chiriac H. Moga AE. Urse M. Necula F. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):159-161, 1999

In this paper we present some results concerning the preparation of nanocrystalline Fe₈₆Cu₁Nb₃Zr₄B₆ powders by high-energy ball milling of elemental powders, in argon atmosphere and their magnetic properties. By controlled heat treatment of powders obtained by mechanical alloying an improvement in the magnetic properties can be noticed.

[31] MOSSBAUER ANALYSIS OF THE PHASE DISTRIBUTION PRESENT IN NANOPARTICULATE FE/SIO₂ SAMPLES

de Julian C. Alcazar GAP. Cebollada F. Montero MI. Gonzalez JM. Marco JF. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):175-177, 1999

Results are presented on the phase distribution and magnetic properties of nanoparticulate Fe/SiO₂, samples prepared by high-energy ball milling. From our data, we suggest that the elevated coercivities measured in the samples are linked to the coupling of the core of the particles (alpha-Fe) with a highly disordered phase present in their surface region and whose behavior exhibits some similarities with a spin-glass phase.

[30] MOSSBAUER AND TEM STUDY OF FE-CR POWDERS ELABORATED BY MECHANICAL ALLOYING

Lemoine C. Fnidiki A. Lemarchand D. Teillet J. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):184-186, 1999

A Cr₈₀Fe₂₀ alloy was elaborated by mechanical alloying, in a planetary mill, from powder mixture of elemental Fe and Cr. Mossbauer spectrometry was performed to follow the formation of the alloy which is paramagnetic at 300 K. The weight of the magnetic contribution due to the incompletely alloyed alpha-Fe, decreases linearly with the milling time. Powder particle microstructure was studied by TEM. The micrometer particles consist of nanocrystalline grains of about 5-15 nm. After 12 h of milling, the Cr₈₀Fe₂₀ alloy seems to be highly disordered than after 3 h.

[29] STRUCTURAL INVESTIGATION OF THE HIGH-ENERGY MILLED FE-SI SYSTEM

Stevulova N. Buchal A. Petrovic P. Tkacova K. Sepelak V. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):190-192, 1999

The binary Fe-Si powdered system (3 : 1 in atomic proportion) has been milled for different times in a planetary ball mill. The changes in microstructure of mechanochemical prepared samples were performed using XRD and Mossbauer spectroscopy. The alloying process was divided into three stages. The first region is associated with the crystalline-to-amorphous phase transition of Si as well as with the introduction of defects into the more easily disturbed Fe particles. In the second region the large structural changes in BCC-Fe-lattice were observed, which indicated the partial formation of the solid solution. In the third region the mechanically induced ordering of Fe₃Si takes place.

[28] STRUCTURAL AND MAGNETIC PROPERTIES OF MECHANICALLY ALLOYED CO₂₀CU₈₀ SOLID SOLUTION

Yoo YG. Yang DS. Yu SC. Kim WT. Lee JM. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):193-195, 1999

Microstructural change during the mechanical alloying of Co₂₀Cu₈₀ has been studied by X-ray diffractometry (XRD) and extended X-ray absorption fine structure (EXAFS) techniques. EXAFS analysis shows clearly the formation of supersaturated Co₂₀Cu₈₀ solid solution with FCC crystal structure during mechanical alloying, which is in good agreement with XRD analysis. Magnetic properties also have been studied by SQUID magnetometer from 4 to 290 K. The supersaturated Co₂₀Cu₈₀ solid solution shows wide distribution in Co cluster size due to the continuous blocking of Co cluster as a function of temperature.

[27] COERCIVITY ANALYSIS IN THE CO-X/(SIO₂)(100-X) NANOPARTICULATE SYSTEM

Montero MI. Emura M. Cebollada F. Gonzalez JM. Gonzalez EM. Vicent JL. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):205-207, 1999

We have prepared, by using a high-energy ball mill, samples consisting of Co nanoparticles (average diameters in the range from 7 up to 15 nm) dispersed in SiO₂. The coercivity of these samples has been measured as a function of the Co volume percentage, the milling time and the temperature. Our results show that, at temperature above 100 K, the coercive force depends on temperature according to the law corresponding to isotropic uniaxial superparamagnetic particles. Below 100 K the occurrence of interparticle interactions originate measurable departures from that law.

[26] MAGNETIC PROPERTIES OF DISORDERED GRAIN BOUNDARIES IN NANOCRYSTALLINE FERH ALLOYS

Hernando A. Navarro E. Yavari AR. Fiorani D. Rosenberg M. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):223-225, 1999

Starting from different compositions of FeRh a nanocrystalline FCC phase, paramagnetic at room temperature, has been obtained, through mechanical alloying by ball milling. At low temperature, glassy behaviors have been observed in all compositions. The shifted hysteresis loop observed after field cooling as well as the remarkable irreversibility at high fields indicate that the grain boundaries behave as spin-glass like.

[25] EXPERIMENTAL ESR STUDIES OF NANO-SIZE MAGNETIC HETEROGENEITIES IN POLYCRYSTALLINE LA_{0.5}PB_{0.5}MNO₃ AND LA_{1.34}SN_{0.66}MN₂O₇

Shames AI. Rozenberg E. Gorodetsky G. Revzin B. Mogilyanski D. Pelleg J. Felner I. - Journal of Magnetism &

Magnetic Materials. 203(Special Issue SI):259-261, 1999

Electron spin resonance spectra of $\text{La}_{0.05}\text{Pb}_{0.5}\text{MnO}_3$ and $\text{La}_{1.34}\text{Sn}_{0.66}\text{Mn}_2\text{O}_7$ powder samples have been investigated in the temperature range, 120-500 K. The spectra exhibit a gradual narrowing of the ferromagnetic resonance signal, upon increasing the temperature and approaching Curie temperature, T_c . The temperature dependence of the linewidth and the double integrated resonance intensity are attributed to ferromagnetic inhomogeneities.

[24] CHANGES OF MAGNETIC PROPERTIES OF FE₅₀MN₅₀ COMPOSITION AT MECHANICAL ALLOYING

Toporov AY. Kiselev MR. Kaloshkin SD. Tcherdyntsev VV. Tomilin IA. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):310-312, 1999

The changes of magnetic properties, structure and phase composition of Fe₅₀Mn₅₀ alloy obtained at mechanical proceeding of the initial mixture of elemental powders in a planetary ball mill were studied. Single-phase state (FCC) was obtained after 30 min of proceeding. Coercivity of studied composition increases as the (ECC) phase appears and continues to increase even after the complete transformation of the alloy structure into FCC phase. Induction of the Fe-Mn powder decreases within the total processing period of time while the squareness ratio of hysteresis loop distinctly increases. The obtained data can be explained by antiferromagnetic FCC phase formation: as well as by an increase of defectivity of structure at milling.

[23] TRANSFORMATIONS AND FINE MAGNETIC STRUCTURE OF MECHANICALLY ALLOYED FE-NI ALLOYS

Baldokhin YV. Tcherdyntsev VV. Kaloshkin SD. Kochetov GA. Pustov YA. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):313-315, 1999

Structure and phase composition as well as fine magnetic structure of mechanically alloyed (MA) Fe_{100-x}Ni_x compositions (x = 10, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 50, 60, 70, 80, 90 at%) were investigated by Mossbauer spectroscopy and X-ray diffractometry. The concentration ranges of existence of single-phase solid solutions for samples prepared by MA technique were extended comparing with the equilibrium alloys. Specialities of fine magnetic structure of as prepared and annealed MA samples were found to be in a good agreement with their phase composition.

[22] STUDY ON THE MAGNETIC BEHAVIOR OF NANOGRANULAR CU₈₀FE₁₀CO₁₀ SOLID SOLUTION

Yu SC. Song YY. Kiss LF. Vincze I. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):316-318, 1999

Supersaturated Cu₈₀Fe₁₀Co₁₀ alloy with a grain size of about 20 nm confirmed by X-ray diffraction was prepared by mechanical alloying from Cu, Fe and Co (- 80 mesh, 99.9%) powders. Both room temperature field-dependent and temperature-dependent (FC and ZFC) DC magnetization data, and temperature-dependent AC susceptibility data measured at various frequencies hint at the simultaneous presence of ferromagnetic and superparamagnetic clusters in this alloy. Room temperature Mossbauer results suggest that the Fe atoms are located in a paramagnetic environment, thus the magnetic clusters should be composed mainly of Co atoms.

[21] FREQUENCY BEHAVIOUR OF ZN-MN FERRITES NANOPARTICLES OBTAINED BY HIGH-ENERGY BALL MILLING

Arcos D. Valenzuela R. Vazquez M. Vallet-Regi M. - Journal of Magnetism & Magnetic Materials. 203(Special Issue SI):319-321, 1999

Zinc-manganese spinel ferrites have been obtained by high-energy ball milling from precursors (1) oxides and carbonates and (2) acid oxides and hydroxides. Results reveal that the use of one or another precursor leads to final products with different structural and magnetic characteristics. Measurements of the domain wall relaxation frequency exhibited differences depending on the type of precursor. These results are interpreted in terms of the variations in the magnetocrystalline anisotropy between the samples.

[20] MECHANOCHEMICAL SYNTHESIS OF FERROFERRIBORATE (VONSENITE, FE₃BO₅) AND MAGNESIUM FERROFERRIBORATE (LUDWIGITE, FE₂MGB₅)

Mitov I. Cherkezova-Zheleva Z. Mitrov V. Kunev B. - Journal of Alloys & Compounds. 289(1-2):55-65, 1999

Mossbauer spectroscopy and X-ray diffraction have been used to follow the evolution of the phase composition during mechanochemical synthesis of ferroferriborate (vonsenite) and magnesium ferroferriborate (ludwigite). The properties of the compounds obtained have been compared with those of samples prepared by a solid-phase thermal method. It has been established that the samples prepared by the two methods have similar compositions and cation distributions, but differ in crystallite size, specific surface area and crystal structure perfection.

[19] SYNERGY OF HYDROGEN SORPTION IN BALL-MILLED HYDRIDES OF MG AND MG₂NI

Zaluska A. Zaluski L. Strom-Olsen JO. - Journal of Alloys & Compounds. 289(1-2):197-206, 1999

A remarkable enhancement of hydrogen desorption kinetics has been found for magnesium-based materials, ball-milled in the hydrogenated state. Ball-milling has been used to introduce both strain and structural changes in the hydrides of Mg, Mg₂Ni and their mixtures, facilitating desorption of hydrogen and reducing the operational desorption temperature. Moreover, ball-milling of the mixtures of MgH₂ and Mg₂NiH₄ results in a synergetic effect of desorption, allowing the mixture to operate at temperatures of 220 degrees C-240 degrees C, with excellent absorption/desorption kinetics and with total hydrogen capacity exceeding 5 wt.%. This behaviour has been maintained over hydrogenation cycling. It is concluded that mechanically-treated hydrides offer a new opportunity for magnesium-based materials, exploiting the high capacity of magnesium hydride while operating at much lower temperature than conventional MgH₂.

[18] BONDED SM-FE-(TA)-N MATERIALS PRODUCED VIA ATTRITOR MILLING AND HDDR

Zuzek K. McGuinness PJ. Kobe S. - Journal of Alloys & Compounds. 289(1-2):265-269, 1999

An alloy of composition Sm_{13.8}Fe_{82.2}Ta_{4.0} was compared with a more conventional Sm_{13.7}Fe_{86.3} binary material in order to assess Ta as a potential additive for SmFe-based permanent magnet materials. The optimum conditions necessary to provide the highest coercivities using only the HDDR process, and for the HDDR process combined with a pre-attritor milling stage were investigated. The coercivities obtained after using the HDDR process and subsequent nitriding were 680 kA/m for the SmFeTa_n and 360 kA/m for the SmFeN samples. Coercivities of 1010 kA/m for

SmFeN and 1280 kA/m for SmFeTaN were achieved by reducing the particle size to about 5 μm with attritor milling prior to the HDDR process. The magnetic results were compared with the phase composition, determined using scanning electron microscopy (SEM) and X-ray diffraction (XRD) and the grain size of the recombined material (SEM). The better coercivities obtained with the Ta-containing sample were found to be due to the presence of a much smaller amount of $\alpha\text{-Fe}$, a soft magnetic phase, with a TaFe_2 phase forming in its place. The attritor milling prior to the HDDR treatment improves the magnetic properties because of the small particle size, produced by attritor milling prior to the HDDR process, which physically prevents the growth of large grains, with their consequent very negative effect on the coercivity.

[17] HIGH ENERGY BALL MILLING OF (Zr,La)(V,Ni)(2.25) UNDER HYDROGEN

Journal of Alloys & Compounds. 289(1-2):L6-L9, 1999

The effect of high energy ball milling (HEBM) on the electrochemical behaviour of $(\text{Zr,La})\text{V}_{0.56}\text{Ni}_{1.69}$ electrode material has been investigated. XRD analysis showed that, after 40 h HEBM the alloy had decomposed into an amorphous phase. The discharge capacity of amorphous $\text{Zr}_{0.975}\text{La}_{0.025}\text{V}_{0.56}\text{Ni}_{1.69}$ material decreased from 240 mA h g⁻¹ to 0 mA h g⁻¹. Following annealing in high-purity argon at 1070 K for 1 h, XRD confirmed the formation of the cubic C15-type structure. At this stage, in nanocrystalline $(\text{Zr, La})\text{V}_{0.56}\text{Ni}_{1.69}$ material a discharge capacity of 126 mA h g⁻¹ (40 mA g⁻¹ discharge current) has been measured.

[16] CATALYTIC REDUCTION OF NO BY HYDROCARBONS OVER A MECHANICAL MIXTURE OF SPINEL NI-GA OXIDE AND MANGANESE OXIDE

Chen LY. Horiuchi T. Mori T. - Catalysis Letters. 60(4):237-241, 1999

NO reduction with propylene over Mn_2O_3 , spinel Ni-Ga oxide and their mechanical mixtures has been investigated. Mn_2O_3 has no activity to NO reduction, but has a high activity for NO oxidation to NO_2 . Spinel Ni-Ga oxide showed an apparent activity to NO reduction only at temperatures above 400 degrees C. Mixing of Mn_2O_3 to the Ni-Ga oxide resulted in a significant enhancement of NO reduction in the temperature range of 250-450 degrees C. The optimal Mn_2O_3 content in the mixture catalyst was about 10-20 wt%. It is suggested that the synergetic effect of Mn_2O_3 and Ni-Ga oxide plays an important role in the catalysis of NO reduction. The Ni-Ga oxide and Mn_2O_3 mixture catalyst is superior to Pt/ Al_2O_3 and Cu-ZSM-5 by showing a higher NO reduction conversion, resistance to water and negligible harmful by-product formation. Other lower hydrocarbons C_2H_4 , C_2H_6 and C_3H_8 also give a maximum NO reduction conversion as high as 50%. The difference from using C_3H_6 is that the temperature at the maximum NO reduction is higher than it is with C_3H_6 .

[15] REDUCTION OF POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS IN CONTAMINATED MUDS BY MECHANICALLY INDUCED COMBUSTION REACTIONS

Monagheddu M. Mulas G. Doppiu S. Cocco G. Raccanelli S. - Environmental Science & Technology. 33(14):2485-2488, 1999

Some selected results are reported from an ongoing study concerning mechanochemical dehalogenation reactions carried out under autopropagating high-temperature regimes. Our work shows that instantaneous burning reactions can be ignited in highly exothermic systems involving chloroorganics when subjected to intensive mechanical treatments. A reference trial using calcium hydride-hexachlorobenzene is first presented. No residual traces of the organohalide compound were found in the reacted powders or in the gaseous phase sampled from the headspace of the milling reactor. The solid products of the reaction were restricted to CaHCl and CaCl_2 salts and graphite. Similar combustion-like phenomena were observed when contaminated mud samples were added to initial reactants. The contaminated mud was obtained from a waste site and contained traces of polychlorodibenzodioxins and polychlorodibenzofurans. It was observed that an effective chemical oven was created which caused the thermochemical breakdown of the hazardous compounds. A transformation yield greater than 99.6% was obtained with a decrease of the toxic equivalent concentration from 2492 to 0.788 $\mu\text{g}/\text{kg}$. Unlike conventional incineration methods, the mechanically induced burst processes run under a strictly confined environment and controlled conditions.

[14] FORMATION OF SrVO_3 PRECURSORS FROM $\text{Sr}(\text{OH})_2$ AND VmOn ($2/5 \leq m/n \leq 2/3$) BY MECHANICAL STRESSING UNDER AMBIENT OR REDUCING ATMOSPHERE

Lee WS. Isobe T. Senna M. - Solid State Ionics. 123(1-4):293-300, 1999

Mechanochemical and subsequent heating processes to produce SrVO_3 are studied, starting from a mixture of $\text{Sr}(\text{OH})_2$ and VmOn ($2/5$ less than or equal to m/n less than or equal to $2/3$) by milling and heating in an ambient or reducing atmosphere. Single phase perovskite SrVO_3 was obtained by firing the milled mixtures at 1300 degrees C under reducing atmosphere with four dehydration steps via two intermediates, $\text{Sr}_2\text{V}_2\text{O}_7$ and $\text{Sr}_8\text{V}_8\text{O}_{25}$. The fourth dehydration step, corresponding to transformation of $\text{Sr}_8\text{V}_8\text{O}_{25}$ to SrVO_3 , appears at around 1100 degrees C by heating mixtures containing trivalent vanadium and milled in a reducing atmosphere. Dehydration of the mixtures was promoted by milling under N-2-4% H-2, due to reduction of precursors by hydrogen. The precursor from the mixture with III-V mixed-valent vanadium milled under N-2-4% H-2 is closer to the final product SrVO_3 than any other precursors.

[13] ACID-BASE PROPERTIES AND CATALYTIC ACTIVITY OF NANOPHASE CERIA-ZIRCONIA CATALYSTS FOR 4-METHYLPENTAN-2-OL DEHYDRATION

Cutrufello MG. Ferino I. Solinas V. Primavera A. Trovarelli A. Auroux A. Picciau C. - Physical Chemistry Chemical Physics. 1(14):3369-3375, 1999.

The room-temperature high energy ball-milling technique was used to prepare nanophase $\text{Ce}_{1-x}\text{Zr}_x\text{O}_2$ ($x = 0; 0.2; 0.5; 0.8; 1$) catalysts. The acid-base properties of these catalysts were investigated by means of adsorption microcalorimetry, using NH_3 and CO_2 as probe molecules. The catalytic activity for 4-methylpentan-2-ol dehydration was tested at atmospheric pressure in a fixed-bed flow microreactor. The inclusion of increasingly high contents of zirconium into the ceria lattice has a complex influence on the acidity and basicity of the pure parent oxide, in terms of both number and strength of the sites. A maximum in 1-alkene selectivity is observed for the ceria-rich catalyst and

a minimum for the zirconia-rich sample. Catalytic results are correlated with the acid-base properties and can be interpreted in the light of the mechanism formerly proposed for zirconia, ceria and lanthania. Surface conditioning of the zirconia-rich catalyst occurs during the run, resulting in a remarkable variation of selectivity.

[12] CYCLIC SOLID-STATE TRANSFORMATIONS DURING BALL MILLING OF ALUMINUM ZIRCONIUM POWDER AND THE EFFECT OF MILLING SPEED

El-Eskandarany MS. Aoki K. Sumiyama K. Suzuki K. - Metallurgical & Materials Transactions A-Physical Metallurgy & Materials Science. 30(7):1877-1880, 1999

[11] RECRYSTALLIZATION ACTIVATION ENERGY IN MECHANICALLY ALLOYED OXIDE-DISPERSION-STRENGTHENED METALS MEASURED BY DIFFERENTIAL SCANNING CALORIMETRY

Sha W. - Metallurgical & Materials Transactions A-Physical Metallurgy & Materials Science. 30(7):1885-1887, 1999

[10] HYDRIDING REACTIONS INDUCED BY BALL MILLING IN GROUP IV AND V TRANSITION METALS

Dunlap RA. Small DA. Mackay GR. - Journal of Materials Science Letters. 18(11):881-883, 1999

[9] PREPARATION OF NANO-SIZED BI-YIG PARTICLES FOR MICRO OPTICS APPLICATIONS

Kuroda CS. Kim TY. Hirano T. Yoshida K. Namikawa T. Yamazaki Y. - Electrochimica Acta. 44(21-22):3921-3925, 1999.

Nano-size Bi-YIG (Bi substituted Yttrium Iron Garnet: $\text{Bi}_{1.8}\text{Y}_{1.2}\text{Fe}_5\text{O}_{12}$) particles and their coated film were prepared. The particles were made by coprecipitation and heat treatment processes. The magnetic ink and coated films were prepared with milling and printing techniques. We optimized the ink preparation and coating conditions. The particles in the films were observed by a transmission electron microscope and an atomic force microscope. The size of the coprecipitated particles was about 10-20 nm, The milled particles size was the same as the coprecipitated particle. The magnetic and magneto-optical properties of the particles and coated films were investigated. The maximum value of the figure of merit was 1.5 degrees which was comparable to the value of a sputtered film. The magneto-optical ink and coated film are new materials for magneto-optical devices.

[8] THE EFFECT OF BALL MILLING ON THE MAGNETIC PROPERTIES OF HDDR PROCESSED ND-FE-B MAGNETS

FA Actis, MC Saracco, JC Quinteros, H Nagel - MAGNETISM, MAGNETIC MATERIALS AND THEIR APPLICATIONS (Series: MATERIALS SCIENCE FORUM), 1999, Vol 302-3, pp 319-323

Nd-Fe-B powders produced through the HDDP (Hydrogenation, Disproportionation, Desertion, Recombination) process are coarse (mean particle size of 1000-2000 μm). They need to undergo a deagglomeration step prior to pressing. If they are to be used in the production of compression molded bonded magnets in order to improve die cavity filling conditions. In the present work the effect of ball milling time on the particle size distribution, particle shape and tap density of isotropic powders is studied, Magnetic properties and density of compression molded magnets are also evaluated. HDDR produced powders are very friable therefore a sharp decrease in the mean particle size is obtained even for short milling times. Powders milled for 15-20 minutes show improved flowability and reach higher densities during compaction. Angular shapes with sharp edges are characteristic of particles obtained through the HDDR process. Ball milling deagglomeration of such particles strongly changes the size distribution but without introducing dramatic changes in particle shape. As a result of particle size reduction intrinsic coercivity is lowered from 1000 kA/m, in the as produced coarse powder, to 900 kA/m in the material milled for 60 minutes. However, because of its better compacting behaviour milled powders develop higher remanence. Optimum density of 6.0 g/cm³ was achieved for milling times of 15-20 minutes. For that conditions isotropic magnets with the following magnetic properties were produced: $H_{ci}=980.6$ kA/m, $B_r=0.446$ T and $(BH)_{(max)}=32.2$ kT/m³.

[7] MICROSTRUCTURAL AND MAGNETIC PROPERTIES OF MECHANOSYNTHESIZED FERRITES

GF Goya, HR Rechenberg - MAGNETISM, MAGNETIC MATERIALS AND THEIR APPLICATIONS (Series: MATERIALS SCIENCE FORUM), 1999, Vol 302-3, pp 406-410

We present a study on microstructure and magnetic properties of the MFe_2O_4 ferrite ($M = \text{Cu}$ and Zn) produced by high-energy ball milling of the precursor mixture $\{\text{MO} + \alpha\text{-Fe}_2\text{O}_3\}$ for times up to 600 h. The resulting properties are compared to the corresponding milled MFe_2O_4 ferrites. It is found that, regardless of the starting phase being MFe_2O_4 or $\{\text{MO} + \alpha\text{-Fe}_2\text{O}_3\}$, samples milled for $t > 400$ h have almost identical phase composition. For milled $\{\text{MO} + \text{Fe}_2\text{O}_3\}$ samples, reduction from $\alpha\text{-Fe}_2\text{O}_3$ to Fe_3O_4 is observed as previous stage to the formation of spinel structure $\text{Fe}_{3-x}\text{M}_x\text{O}_4$ having x approximate to 1. For milled MFe_2O_4 samples, segregation of $\alpha\text{-Fe}_2\text{O}_3$ and subsequent reduction lead to the same $\text{Fe}_{3-x}\text{M}_x\text{O}_4$ phase after t approximate to 400 h. X-ray diffraction (XRD), Mossbauer and magnetization data show that this phase has microstructural and magnetic properties corresponding to x approximate to 1 and substantial short-range disorder. An effective magnetic moment $\mu(\text{eff}) = 2.23$ $\mu(\text{B})$ is obtained for the resulting ZnFe_2O_4 spinel phase, which implies an inversion degree of $\delta = 0.2$. Annealing of milled sample gradually restores the bulk hyperfine parameters and $\mu(\text{eff})$ values. However, the inverted structure is noticed even after annealing at temperatures T approximate to 900 K.

[6] SYNTHESIS OF BA HEXAFERRITE FE MAGNETIC COMPOSITES

PG Bercoff, HR Bertorello - MAGNETISM, MAGNETIC MATERIALS AND THEIR APPLICATIONS (Series: MATERIALS SCIENCE FORUM), 1999, Vol 302-3, pp 435-439

Magnetic composite materials (MCM) had been synthesized from commercially pure Ba hexaferrite and pure iron, by means of high energy ball milling under air or argon atmosphere. Thermal transformations of the ball-milled powder were studied in air and argon atmosphere from room temperature to 1300 K with the aid of DTA (Differential Thermal Analysis). Milling and heat treating in Ar produces $\text{Fe}_3\text{O}_4 + \text{Fe} + \text{BaO}$, with low remanence and coercivity. Milling in air or Ar and heat treating in air produces the formation of phase $M + \text{Fe}_2\text{O}_3$ with coercivity $H_c = 4800$ Oe, close to the larger values obtained by other methods. When milling is produced in air and the heat treatment in Ar, the final product is phase $M + \text{Fe}_3\text{O}_4$ with a nanostructure such that partial exchange coupling occurs among the particles of each phase.

[5] MECHANOMIXING IN VARIOUS IRON-CONTAINING BINARY ALLOYS

G LeCaer, T Ziller, P Delcroix, JP Morniroli - MOSSBAUER SPECTROSCOPY IN MATERIALS SCIENCE (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1999, Vol 66, pp 131-142

[4] MOSSBAUER STUDIES OF BALL MILLED $Fe_{1-x}S_1+x$

L Takacs, VK Garg - MOSSBAUER SPECTROSCOPY IN MATERIALS SCIENCE (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1999, Vol 66, pp 143-150

The influence of high-energy ball milling on iron sulphur powder mixtures $Fe_{1-x}S_{1+x}$ (where $x = -3, 0, 3, 5,$ and 10%) with milling times between two hours and 70 hours have been studied by XRD and Mossbauer spectroscopy. Intensive mechanical milling caused changes in the phase composition and properties of the material, which evoked corresponding changes in the Mossbauer spectra. Most of the reaction takes place in a self-sustained manner over a short interval, in our case some time between 2 and 5 hours, as confirmed by XRD. It seems that the reaction is a three step process, consisting of an initial activation period, than an almost instantaneous, self-sustained chemical change, followed by slow homogenization and reaching a uniform final state. The Mossbauer spectra after 0 and 2 hours of milling consists of the sextet of α -Fe and a nonmagnetic doublet. In all other samples the internal magnetic field of the sextet is close to 270 kOe and the Mossbauer parameters of the doublet are close to those of FeS_2 . In case of samples with 10% excess S, milling results in the presence of FeS_2 . Though we do not know the exact origin of these components yet, the sextet probably reflects the presence of FeS, that is antiferromagnetic at room temperature, and the doublet may originate from FeS_2 in non-crystalline form.

[3] ELECTRODEPOSITED, ION BEAM MIXED AND BALL MILLED FeCrNi ALLOYS - COMPARATIVE STUDY OF FORMATION AND TRANSFORMATION OF METASTABLE PHASES

E Kuzmann, M ElSharif, CU Chisholm, G Principi, C Tosello, K Havancsak, A Vertes, K Nomura, VK Garg, L Takacs - MOSSBAUER SPECTROSCOPY IN MATERIALS SCIENCE (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1999, Vol 66, pp 203-214

Conversion electron and transmission Mossbauer spectroscopy, X-ray diffractometry and electron microprobe analysis were used to perform comparative study of Fe-Cr-Ni electrodeposited, ion beam mixed vacuum deposited and ball milled alloys of same composition around 50%Fe-25%Cr-25%Ni. The main phase of the electroformed Fe-Cr-Ni microcrystalline samples is ferromagnetic contrary to the paramagnetic character of thermally prepared alloys of equivalent composition. Metastable phases have been shown in Fe-Cr-Ni multilayers, consisting of a few atomic layers of iron and nickel as well as chromium, prepared by high vacuum deposition and ion beam or laser irradiation. The main phase of evaporated and ion beam mixed Fe-Cr-Ni films has been found to be ferromagnetic similarly to that observed in the case of electrodeposited alloys. It was shown that transformation of metastable phases into the stable one occurs in high vacuum evaporated and ion beam mixed or laser irradiated Fe-Cr-Ni films due to appropriate heat treatment in vacuum. Transformation of metastable phases in electrodeposited Fe-Cr-Ni alloys was achieved by irradiation with energetic heavy ions at room temperature. Metastable phases, including the ferromagnetic one, were found in Fe-Cr-Ni alloys prepared by ball milling method, too.

[2] DISORDERED NANOCRYSTALLINE Fe-Sn ALLOYS - Fe-57 AND Sn-119 MOSSBAUER SPECTROSCOPY STUDY

EP Yelsukov, EV Voronina, GN Konygin, SK Godovikov, VM Fomin - MOSSBAUER SPECTROSCOPY IN MATERIALS SCIENCE (Series: NATO ADVANCED SCIENCE INSTITUTE SERIES, SUB - SERIES 3, HIGH TECHNOLOGY), 1999, Vol 66, pp 283-290

[1] THE INFLUENCE OF NITRATE SALT AS SINTERING ADDITIVES ON MECHANICAL STRENGTH IN SILICON NITRIDE

DC Park, JY Kim, T Iseki, T Yano - TIME DEPENDENT MECHANICAL RESPONSE OF ENGINEERING CERAMICS (Series: KEY ENGINEERING MATERIALS), 1999, Vol 4, pp 131-134

Powder characteristics of Si_3N_4 milled with nitrates additives and oxide additives and their change during heating were compared. XRD, TG-DTA, and TEM were used to characterize the Si_3N_4 powder added with additives. The surface of Si_3N_4 milled with nitrate additives was covered with a different layer from that of Si_3N_4 milled with oxide additives after heat-treatment at 600 degrees C. The thickness of the coated layer was relatively uniform. It was considered that the surface of Si_3N_4 is coated with clusters of M^{3+} - NO_3^- - OH^- system, resulting in a homogeneous distribution of additives, and then improved sinterability and mechanical properties.

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