RESEAU FRANÇAIS DE MECANOSYNTHESE

Lettre N°58

Janvier 2000

168 (+2) Groupes de Recherche

(dont 96 (+2) à l'étranger / 35 Pays)

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

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SOMMAIRE

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2 Nouvelles Adhésions

O. Gutfleisch - IFW Dresden - Dpt Superconductivity & Magnetism - Dresden - Allemagne
Honggang Jiang - Los Alamos National Laboratory - Los Alamos - USA

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 a jour régulièrement concernant les derniers résultats dans ce domaine.

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Web Sites

• Pour ceux intéressés par le devenir du Rayonnement Synchrotron en France / Europe, un site intéressant et particulièrement actif ces dernières semaines

• People interested by the Synchrotron Radiation Development in France / Europe

Website : http://www.Lure.u-psud.fr/actus/avenir

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Corresp. : Eric.Gaffet@utbm.fr

ISMANAM 2000

Oxford (UK) - 9-14th July 2000.

FIRST CIRCULAR &CALL FOR PAPERS

SCOPE

The International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials 2000 (ISMANAM-2000) will take place in Oxford (UK) during the week of 9-14th July 2000. The symposium will be based entirelywithin one of the Oxford colleges, St Catherines College.

The symposium will cover amorphous, nanocrystalline, nanocomposite,mechanically alloyed, quasicrystalline and other metastable materials,providing a comprehensive overview of recent research into : synthesis andprocessing; structural and chemical characterisation; magnetic, electrical, mechanical and other properties; and applications in components and devices. Intended as a forum for novel ideas, the symposium should promote contact between basic research efforts and technological needs for industrial applications.

RELEVANT TOPICS

Contributions are welcome on the following topics concerning highly metastable or nanostructured materials:

* Synthesis and processing (physical, chemical and mechanical methods)
* Characterization
* Thermodynamics and modelling, including atomistic models
* Mechanisms and kinetics of devitrification, loss of metastability and grain coarsening (theoretical and experimental aspects)
* Properties: catalytic, chemical, corrosion, electrical, electrochemical, magnetic, mechanical, optical, tribological, etc.
* Near and long term applications and technological challenges
* Carbon fullerenes and nanotubes
* Thin film layered structures
* Clusters, aerosols and quantum dots

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Dr. Richard Todd

Corresp. : Eric.Gaffet@utbm.fr

Dr. Paul Warren

LOCAL CONTACT

ISMANAM 2000
OCAMAC, University of Oxford
Parks Road, Oxford OX1 3PH, U.K.
fax: +44-1865-283333
e-mail: ISMANAM2000@materials.ox.ac.uk

CONFERENCE LOCATION

The historic cit of Oxford needs little introduction,being internationally renoun as centre for academic achievement. The ancient and beautiful University buildings form the heart of the thriving city centre. The conference will be based entirely within St Catherines College, one of the more modern Oxford colleges.The College's motto - Nova et Vetera (the new and the old) - sums up its unique quality among Oxford colleges and seems rather appropriate for scope of this conference. The conference will make full use of the college's conference and accommodation facilities.

ABSTRACTS

The abstract deadline is February 1st, 2000. Authors are encouraged to submit abstracts of about 200-400 words in electronic format (www, email or floppy disk) or on paper.Detailed abstract instructions are specified on the conference web site.

DEADLINES

* February 1st - Submission of abstracts
* March 1st - Acceptance of abstracts
* April 1st - Early registration deadline
* June 11th - Late registration deadline
* July 9th - Manuscript Deadline

NANOS-2000

Elaboration, characterisation, properties and applications of **Nanomaterials**

International workshop
to be held in IMP* Odeillo/Font Romeu, France
2000, January 25th to 28th

After NANOS-94, NANOS-96, NANOS-98, the time is reached for NANOS-2000. Participants to the previous meetings have expressed wishes to meet them again in 2000. The topic "Nanostructured Materials" (or Nanomaterials) is now present in many conferences, but it is in small meetings (less than 100 people) where the exchanges are fruitful and cooperative work develops.

As the others workshops of the series, the next NANOS will be held again in Odeillo/Font Romeu, from January 25th to January 28th. The meeting could take place from the morning to the night but with a break from 12.30 to 4.30 pm everyday and thursday a break full afternoon.

Sessions will take place in the seventh floor of the IMP Odeillo laboratory (solar furnace).

The scientific programme will be organised as forty minutes lectures and oral communications of twenty minutes ; (including or excluding ten minutes discussion, depending on the number of communications registered). Poster sessions will provide opportunities to discuss in detail the oral contributions and additionnal papers. Depending on the spectrum of contributions, special sessions will be organised on selected topics such as : nanoscopic granular matter, aggregates, ultrafine powders, fullerenes and nanotubes, nanoporous silicon, nanostructured films and membranes, massive nanomaterials, nanocermets, nanomaterials with magnetic properties, nanomaterials for mechanical applications, nanomaterials with remarkable transport properties, nanomaterials with high chemical reactivity, nanomaterials with optical properties, active photonic crystals, nanosystems... An effort should be done to cover the applications and the fundamental aspects as well. Papers will be selected during the meeting to be submitted to the EPJ (European Physical Journal : Applied Physics). We are negociating a simultaneous publication of the first accepted papers in one issue ; people wishing to submit a paper for publication have to bring the paper with them.

Two booklets will be provided to the participants : one with the abstracts sent on time (deadline : 2000 January 3rd), the second collecting information on the activity of laboratories on nanomaterials : organisation name, adress, list of persons involved in this field (with their speciality and e-mail), list of publications related to nanomaterials, participation to networks working more or less on nanomaterials (references for contacting) , collaboration needs... The purpose of such document is to increase (or to create) links between people. A synthesis of the document will be presented during the meeting.

Corresp. : Eric.Gaffet@utbm.fr

This workshop lets place to existing research nets*** to meet themselves, to present papers in the frame of the workshop and to prepare the future. Time and rooms will be available for these people to have private discussions if they need it.

The registration fee (800 F for four days) will cover the lunch meals + extra expenses (secretariat, transportations, coffee breaks...). Accomodation (bed, breakfast and dinner) can be taken in neighbouring hotels (negociated prices) but the lunches and the workshop dinner will be taken together in one of the hotels. Skying will be possible after lunch in the close station (yet open) for those who will decide to relax. Reservations for the week-ends before and after the meeting can be made by yourself, directly to the hotels.

We need to know your participation as fast as possible. Could you fulfill the following forms and send them us with the registration fee before December 15th.

With the best regards,

On behalf of the organizing committee**
Claude Monty

* **IMP :** "Institut de Science et Génie des Matériaux et Procédés" is a part of the European Research Laboratory SIMAP including the "Institut de Ciencias de Materiales de Barcelona" (ICMAB), the "Laboratoire des Matériaux et Procédés Membranaires" in Montpellier University and the two components of the IMP : one located in the Perpignan University or close (Pôle Carnot) and the other in Odeillo /Font Romeu. (http://www.imp-odeillo.fr)

** **Organizing committee :**
René Berjoan, Gilles Flamant, Sylvain Mauran, François Sibieude, Francis Teyssandier,
Chairman : Claude Monty (monty@imp-odeillo.fr)
Secretary : Claudie Seimpere (claudie@imp-odeillo.fr)

Advisory board :
Marie-Isabelle Baraton, Maria-Dolorès Baro, Guy Blaise, Yannick Champion, Christian Colliex, Louis Cot, Albert Figueras, Joseph Fontcuberta, Eric Gaffet, Jacques Lafait, Michel Lanoo, Daniel Laplaze, Carlos Miravitlles, Xavier Obradors, Jean-Pierre Peyrade, Bernard Spinner.

*** **Contacted Research Nets :**

CTP "Nanosystèmes magnétiques et applications" et réseau-CTP "Manganites : matériaux massifs et couches minces. Etude des propriétés magnétiques"

GDR "Effets Mécaniques-Electriques corrélés dans les isolants"

RFM "Réseau Français de Mécanosynthèse"

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

Scope : The Conference continues in the tradition established by the INCOMEs held in 1993 in Slovakia and in 1997 in Russia. It will provide a comprehensive overview of research in mechanochemistry of dispersed solids and application of this rapidly evolving field of solid state chamistry and physics in various areas of industry.
In view of the great interest in nanostructured materials and the importance of mechanical alloying in the development of novel, high performance materials, the conference is intended to bring together international researchers from academia and industry to present the state-of-the-art and to discuss future research directions and practical applications.

The 3rd INCOME will be held in conjunction with the conference Solid State Chemistry 2000 (SSC2000, http://www.iic.cas.cz/ssc2k.htm). Metal oxides, non-traditional glass and non-traditional syntheses that are closely related to the actual problems of mechanochemistry, will be among the topics of SSC2000.

Conference topics:
1. Fundamentals and models of mechanically stimulated processes.
2. Mechanically induced changes in structure and properties of solids.
3. Mechanochemical reactions and enhancing of self-sustaining reactions by mechanical activation.
4. Methods and equipment for preparing and characterization of active powders.

Contacts:
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CZ-250 68 Rez, Czech Republic
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Phone: +420-2-66172096 or +420-2-66173114

Conference committeeís chairperson:
Klara Tkacova
Technical University of Kosice,
SK-042 00 Kosice, Slovak Republic
e-mail: jantkac@dodo.sk
Phone: +421-95-6331090

More details about the conference and preliminary registration form can be requested from the webpages indicated above.

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ANNONCE DE CONGRES ET / OU ECOLES
CONGRESS AND SCHOOL ANNOUNCEMENTS

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PROCESSING AND CATALYTIC/CHEMICAL PROPERTIES OF NANOSTRUCTURED MATERIALS
January 16-21, 2000
Maui, Hawaii

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 - Nashvile 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
Contacts : Champion@glvt-cnrs.fr et/ou Eric.Gaffet@utbm.fr

JRFM'2000
23 - 24 Mai 2000 - Bordeaux France
Wbesite : http:://www.bls.fr/amatech

III European Conference on Fluidization
29 - 31 Mai 2000 - Toulouse - France
E_Mail : Progep@ensigct.fr

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

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/Materials/OCAMAC/ISMANAM/ISMANAM2000.html

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NCM8
8th International Conference on the Structure of Non - Crystalline Solid
6 - 11 Aout 2000
Website : http://www.sgt.org

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
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

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

The 1st International Conference on Advanced Materials Processing
Rotorua, New Zealand, 19-23 November 2000.
Secretary, ICAMP 2000,
Department of Materials and Process Engineering The University of Waikato
Private Bag 3105, Hamilton, New Zealand
Fax: 64-7-838 4835, e-mail: d.zhang@waikato.ac.nz
Or visit the conference web site:
http://mape.waikato.ac.nz/conferences/amp.htm

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

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SOUTENANCE DE THESE
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F.Charlot
Etude et compréhension des réactions auto-entretenues activées mécaniquement. Elaboration du composé FeAl nanostructuré.

6 Déc. 1999 - Université de Technologie de Belfort - Montbéliard
Nanomatériaux : Elaboration et Transitions de Phases Hors Equilibre, UPR 806 CNRS, UTBM - Sévenans.
Matériaux à Grains Fins, LRSS UMR 5613 CNRS-Université de Bourgogne.

Jury (Provisoire) :
G. Bertrand, G.LeCaer (Rapp.) , F.Thévenot (Rapp.) , F.Bernard (Co - Dir.), E.Gaffet (Co - Dir.), J.C.Gachon, M.Bessière, M.Gailhanou

L'objectif de ce travail est d'obtenir à partir d'un procédé de synthèse non conventionnel, le procédé MASHS, un matériau nanostructuré et dense. Ce procédé appliqué à la synthèse du composé FeAl, repose sur deux étapes : (i) une première étape dite d'activation mécanique (MA) qui est un prébroyage énergétique de courte durée conduisant à des poudres précurseurs nanostructurées. (ii) la seconde étape consiste à synthétiser des composés ayant une enthalpie de formation négative par une réaction SHS (Self-propagating High-temperature Synthesis. Une partie du travail a été, dans un premier temps, d'étudier l'influence des différents paramètres contrôlant ce procédé MASHS et, dans un second temps, de comprendre les chemins conduisant à ce matériau nanostructuré à partir d'un dispositif original autorisant le suivi in-situ et en temps réel des réactions de combustion en utilisant la diffraction des rayons X (rayonnement synchrotron) couplée à une thermographie infrarouge.

Il a été mis en évidence plusieurs modes d'activation mécanique, le mode de friction et le mode choc direct grâce au contrôle des conditions de broyage appliquées. Il a été clairement démontré que l'utilisation de poudres activées mécaniquement (friction ou mode direct) entraîne une diminution de la température d'amorçage d'au moins 100° C de la réaction de combustion ainsi qu'une vitesse de front de propagation multipliée par 4/5. Ces différentes modifications sont liées à l'existence de la nanostructure induite au cours du broyage. Une des autres conséquences importantes est l'obtention d'échantillons chimiquement homogènes. Les études in-situ en temps réel ont mis en valeur deux phénomènes, le premier est l'existence d'une phase liquide qui implique que la réaction est de type solide-liquide, le second est l'observation d'une phase transitoire, la forme allotropique gamma du fer.

Bien que le procédé MASHS permettent d'obtenir en une seule étape la phase désirée nanostructurée, un des points faibles reste le problème de la densification (densité relative comprise entre 70 et 80 %). Un procédé expérimental a été développé, en collaboration avec Z.A.Munir, permettant de synthétiser, de densifier et d'obtenir une nanostructure en une seule étape. Ces résultats permettent maintenant d'aller vers la compréhension de la granulo-dépendance des propriétés mécaniques.

The purpose of this work is to obtain a densified nanostructured materials with the application of a new process, the MASHS process. This process is applied to elaborate the FeAl compound. This ones involves mainly the combination of two steps; the first step, a mechanical activation, where pure elemental powders were co-milled to obtain precursor nanometric mixture, the second step, a Self-propagating High-temperature Synthesis (SHS) reaction, which uses the exothermicity reaction. A first step is to determine the parameters which control the different steps of MASHS reaction. The second step is to study the reactional mechanisms with an in-situ in real time study using X-ray diffraction (synchrotron beam) coupled with an infrared thermography. We have demonstrated that different kinds of mechanical activation exists (friction mode, direct shock mode), using the mechanically activated powders, the ignition temperature decreases (more than 100° C), the velocity of the combustion front increases (x 4/5) and the product are more homogeneous. The in-situ in a real time investigation shows the existence of a liquid phase, the reaction is solid-liquid, and an intermediate phase, the gamma iron. The MASHS process doesn't allow to obtain a nanodense material. A following work, with the collaboration of Z.A.Munir, allows to synthesize and densify in a one step a nanostructured materials.

Frédéric BERNARD
25 Novembre 1999 - Amphi de l'ESIREM - Dijon
De l'introduction de " mécanique " dans l'élaboration de la poudre au massif nanométrique vers la maîtrise des propriétés thermomécaniques.

Jury :
D.LOUER, Directeur de Recherches CNRS(Université de Rennes II) rapporteur
H. VAN DAMME, Professeur (Université d'Orléans) rapporteur
J.C. TEDENAC, Professeur (Université de Montpellier II) Rapporteur
J. FOCT, Professeur (Université de Lille)
G. LE CAER , Directeur de recherches CNRS (Ecole des Mines, Nancy)
G. BERTRAND, Professeur (Université de Bourgogne)
A. NONAT, Directeur de Recherches CNRS (Université de Bourgogne)
J.C. NIEPCE, Professeur (Université de Bourgogne) Date et lieu :

Corresp. : Eric.Gaffet@utbm.fr

Frédérique PERROT-SIPPLE
17 Novembre 1999) Université de Bourgogne - Dijon
Maitrise de la taille de nanograins d'oxydes de structure perovskite pour applications électrocéramiques:
- Synthèse par chimie douce,- Broyage par attrition.
Rapporteurs:
M. J.-M. HAUSSONNE Professeur, Ecole d'Ingénieurs de Cherbourg
M. A. ROUSSET Professeur, Université de Toulouse
Examinateurs
M BEAUGER Alain Ingénieur de Recherche et Développement TPC Saint Apollinaire
M. BERTRAND Gilles Professeur, Université de Bourgogne
M. CHARTIER Thierry Chargé de Recherche, ENSCI de Limoges
M. HUGENTOBLER Denis Directeur Stratégie et Développement ligne céramique, TPC Saint Apollinaire
M. MUTIN Jean-Claude Directeur de Recherche, Université de Bourgogne
Mme RIEUX Nadine Ingénieur de Recherche Alstom-PERT, Massy
Directeurs de thèse:
M. D. AYMES Maître de Conférences, Université de Bourgogne M. P. PERRIAT Professeur, INSA de Lyon

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H. SOUHA
Thèse de Doctorat d'Etat Marocaine
Lieu : Faculté des Sciences Dahr El Mehraz Fes.
Elaboration par recuit et par réaction de combustion du composé Cu3Si à partir d'un mélange de poudres activées mécaniquement. Réactivité du composé Cu3Si vis à vis du chlorure cuivreux.`
Jury :
B. Gillot, G. Bertrand, F. Bernard (Co - Dir.), E. Gaffet (Co - Dir.)

O. 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. Bérar, M. Bessière.

D. Cracco

"Recherche de Nouveaux Alliages Hydrurables de Forte Capacité Massique Utilisable comme Matériaux d'Électrode Négative d'Accumulateur Ni - MH"
CNRS - Thiais - France - 25 Juin 1999
Jury : B. Darriet, L. Schlapbach, B. Knosp, R. Portier, A. Percheron - Guégan

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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

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Cooperative Research on Related Areas
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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

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Ph D Position and Post Doc Position Requests - Proposals

*** Postdoctoral Position Available for a Ph.D Physicist (13th October 1999)

The High-Pressure (HP) group of the School of Physics & Astronomy at Tel Aviv University has a one year position available. This position could be extended to two years.
The HP group is known worldwide as one of the leading groups in experimental HP physics and is on the frontier of HP and diamond-anvil-cells based methodology. The main methods used are:
Mössbauer spectroscopy
X-ray diffraction with synchrotron radiation (ESRF, Grenoble) resistivity
Applicants must be between the final stage of dissertation and within three years of receipt of Ph.D diploma.
For more information, please contact:
Dr. Moshe P. Pasternak
School of Physics and Astronomy
Tel Aviv University
69978 Tel Aviv, ISRAEL
email: hh136@ccsg.tau.ac.il

*** 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 productin 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 Tzukuba) 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 débuterait 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 électrogreffés 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 postions 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
DÈpartement Energie et MatÈriaux
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 MatÈriaux
1650, bd. Lionel Boulet
Varennes, Québec, CANADA
J3X 1S2
E-Mail: HYPERLINK mailto:roue@inrs-ener.uquebec.ca / roue@inrs-ener.uquebec.ca

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Bibliographie Récente

Livres ou "Special Issues"

NOUVEAU (15/11/99)
"Mechanical Alloying : Fundamentals and Applications"
Prof. P.R. Soni (1999) - Cambridge International Science Publishing
web site : http://www.demon.co.uk/cambsi/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 equlibrium 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 workd 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 (Tin,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)

References

Index

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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

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"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'angströms, voire de quelques nanométres. A ces dimensions, les propriétés des matériaux changent radicalement.
Au début des années 90, les japonais ont été les premiers a 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 fied 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 Nancrystalline 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)

[66] WORK-HARDENING MECHANISM DURING SUPER-HEAVY PLASTIC DEFORMATION IN MECHANICALLY MILLED IRON POWDER

Kimura Y. Hidaka H. Takaki S. - Materials Transactions Jim. 40(10):1149-1157, 1999 Oct.

Mechanical milling using a high energy ball mill was applied to a commercial pure iron powder to introduce a large deformation strain into the matrix. Microstructural changes during deformation and annealing were investigated for the mechanically milled powder, by means of X-ray diffractometry, transmission electron microscopy and hardness testing, in order to clarify the work-hardening mechanism of iron during super-heavy plastic deformation. Through the mechanical milling of 360 ks, nanocrystalline grains of 20-50 nm were formed within the powder, and the resultant powder was work-hardened to Hv950. Hardness of the mechanically milled powder mainly depends on the crystallite size(d); the size of dislocation cells, subgrains and nanocrystalline grains. In the mechanically milled powder, a linear relationship was confirmed between hardness and the reciprocal of crystallite size (d(-1)), supporting the strain hardening to Hv500. While it was also confirmed that the work-hardening mechanism of iron gradually changes from strain hardening to grain refining strengthening in the hardness range of around Hv600, where crystalline grains are refined less than 100 nm through heavy deformation. In the hardness range above Hv600, the Hall-Fetch relationship was realized to the crystalline grain size.

[65] SYNTHESIS OF TIAL ALLOYS WITH MAGNESIUM ADDITION THROUGH MA-PULSE DISCHARGE SINTERING PROCESS

Sun ZM. Hashimoto H. Park YH. Abe T. - Materials Transactions Jim. 40(9):879-882, 1999

Titanium aluminides (TiAl) with different magnesium contents of 0, 0.37, 1.84, 3.61 and 15.8 mol% were manufactured through the mechanical alloying and pulse discharge sintering process. The mechanically alloyed TiAl powders with different magnesium contents possessed similar X-ray diffraction profiles, corresponding to alpha titanium. The TiAl powders were sintered for a short sintering time of 900 s, and a complete transformation from the supersaturated alpha titanium structure to TiAl with small amount of Ti3Al phase as well as nitride were confirmed. It was found that the content of Ti3Al phase in the sintered material decreased with an increase in the magnesium content. While the TiAl alloy without magnesium addition showed a submicron structure with equiaxed gamma grains, the microstructure was coarsened by the addition of magnesium. With an increase in the magnesium content the density of the material decreased monotonically, which is attributed to the solution of light magnesium atoms to the TiAl structure and the decrease in the Ti3Al phase content. Small amount of magnesium addition (0.37 mol%) increased the Young's modulus of TiAl alloy, but further increases in the magnesium content decreased the Young's modulus.

[64] COMPOSITION DEPENDENCE OF MICROSTRUCTURE OF MECHANICALLY ALLOYED POWDERS AND THEIR COMPACTS OF HIGH NITROGEN CR-MN STEELS

Miura H. Ogawa H. - Materials Transactions Jim. 40(9):907-910, 1999

Mechanical alloying (MA) of elemental powder mixtures, with an Fe-9.85 mass%N alloy powder as the nitrogen source, of the composition of Cr-Mn type stainless steels was carried out in an Ar atmosphere using a conventional planetary ball mill. In the MA processing of Fe79-x-yCr18MnyMo3Nx (mass%) (x=0.45 and 0.9; y=5-18) material, the MA samples with x=0.9 is austenitized down to near y=8, whereas the MA samples with x=0.45 begin to austenitize near y=11. Fe71.1Cr18Mn10MozN0.9 MA samples with Mo contents (z) in excess of 3% make the austenite phase, formed in the MA powder materials, less stable. Using a hot-rolling technique tried in the current study, the compact sample of Fe68.1Cr18Mn10Mo3N0.9 MA powder material was fully densified, retaining the nanostructure. Addition of AIN to the MA material of Fe68.1Cr18Mn10Mo3N0.9 made it possible to suppress the grain growth in the compact sample, to a considerable extent, during hot-compaction using the rolling process.

[63] DEVELOPMENT OF ROD SHAPE TIAL INTERMETALLICS BY MECHANICAL ALLOYING FOLLOWED BY PULSE DISCHARGE SINTERING METHOD

Shan ZH. Sun ZM. Hashimoto H. Park YH. Abe T. - Materials Transactions Jim. 40(9):957-960, 1999 Sep.

Rod shape intermetallic TiAl is developed by the method of mechanical alloying (MA) followed by pulse discharge sintering (PDS) process for the potential application in the automotive valves. Sintering of powder element mixture, instead of mechanically alloyed powder, was employed for the manufacturing of rod shape TiAl for comparison. The sintered TiAl rods were found to be homogeneous both in density and in microstructure in the axis direction. The effects of alloys' composition and sintering time on the microstructure and mechanical properties were also investigated. This work indicated that rod shape TiAl alloys with thin cross section could be successfully sintered with this process in which uniaxial pressure was applied. The fracture strength of TiAl alloys made by MA-PDS method was found to be much higher than that of sintered elemental compact. Authors Morimoto H. Nakai M. Tatsumisago M. Minami T.

[62] KINETICS OF THE HYDRATION REACTIONS IN THE CEMENT PASTE WITH MECHANOCHEMICALLY MODIFIED CEMENT SI-29 MAGIC-ANGLE-SPINNING NMR STUDY

Johansson K. Larsson C. Antzutkin ON. Forsling W. Kota HR. Ronin V. - Cement & Concrete Research. 29(10):1575-1581, 1999

A comparative Si-29 solid State NMR study of kinetics of the hydration reactions in cement pastes based on rapid-hardening ordinary Portland cement (SH) and on the mechanochemically modified cement (MSH) is presented. The mechanical activation of a cement/silica fume blend in a vibrating mill accelerates the hydration reactions by 15-20%, especially during the initial period of hardening. Variations in relative intensities of Si-29 resonances assigned to the hydration products in SH/MSH blends suggest different structures of hydrated SH nets. This can be correlated with a pronounced increase of the MSH-cement binding capacity reported earlier.

[61] MECHANICAL ALLOYING OF FE-MN AND FE-MN-SI
Liu T. Liu HY. Zhao ZT. Ma RZ. Hu TD. Xie YN. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 271(1-2):8-13, 1999
The ball milling of Fe-24Mn and Fe-24Mn-6Si mixed powders has been performed by the high energy ball milling technique. By employing X-ray diffraction and Mossbauer measurements, the composition evolution during the milling process has been investigated. The results indicate the formation of paramagnetic Fe-Mn or Fe-Mn-Si alloys with a metastable fee phase as final products, which imply that the Fe and Mn proceed a co-diffusion mechanism through the surface of fragmented powders. The thermal stability and composition evolution of the as-milled alloys were discussed comparing with the bulk alloy.
[60] THE CHARACTER OF DISLOCATION STRUCTURE EVOLUTION IN NANOCRYSTALLINE FCCNI-CO ALLOYS PREPARED BY HIGH-ENERGY MECHANICAL MILLING
Salimon AI. Korsunsky AM. Ivanov AN. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 271(1-2):196-205, 1999
The process of dislocation structure evolution and nanocrystalline structure formation during high-energy mechanical milling (MM) was studied in Ni-Co alloys with different stacking fault energy (SFE). X-ray patterns were analysed to determine the lattice microstrain, average crystallite size, probability of the stacking faults and the lattice parameter. Comparison with some other methods of inducing plastic deformation (open-die forging and filing), as well as the analysis of temporal changes in the structural parameters during MM, allowed us to elucidate the sequence of events leading to the formation of a nanocrystalline structure. It was found that SFE is the key factor controlling the process of dynamic recovery. It significantly influences the kinetics of the nanocrystalline structure formation, as well as the steady state structural parameters observed at very long milling times. An anomalous dependence of the lattice microstrain on SFE was also observed. This effect is discussed using a model of the nanocrystalline state composed of dislocation pile-ups separated by high-angle boundaries.
[59] INCREASED DISSOLUTION OF ILMENITE INDUCED BY HIGH-ENERGY BALL MILLING
Chen Y. Williams JS. Campbell SJ. Wang GM. - Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing. 271(1-2):485-490, 1999
High-energy ball milling treatment leads to full dissolution of natural ilmenite sands containing both FeTiO3 and Fe2Ti3O9 phases in a sulphuric acid solution at 100 degrees C. The ilmenite material has been milled for various times in two environments (vacuum and air), and characterised by X-ray diffraction, Mossbauer spectroscopy and surface area analysis. It is found that after milling for only 10 h, 50% of the sample can be dissolved as a result of the increased surface area, nanocrystalline structure and high level of lattice distortion present in the milled sample. Complete dissolution of the ilmenite is obtained on extended milling (200 h) in an oxygen free atmosphere. This occurs as a result of a gradual reduction of the Fe3+ phase (Fe2Ti3O9) to the relatively more soluble Fe2+ phase (FeTiO3) on milling in vacuum. The results overall show that the chemical reactivity of milled materials can be affected significantly by the milling conditions and environment.
[58] THERMAL TREATMENT OF IRON-COPPER METASTABLE ALLOYS
Cohen NS. Odlyha M. Ucko DH. Pankhurst QA. - Journal of Thermal Analysis. 56(1):239-245, 1999
Mechanical alloying is a versatile technique for the solid state synthesis of many materials, including alloys such as iron-copper where the elements are immiscible under equilibrium conditions. The structural and magnetic state of these alloys, and their thermal stability, have been investigated by means of thermomagnetometry, DSC, X-ray diffraction and Mossbauer spectroscopy, Comparison of the thermomagnetometry curves for the various alloys together with analysis of intermediate reaction products enabled the individual thermal processes to be identified. The Curie temperature of the alloys was measured, and it was found that on heating the metastable alloys underwent phase segregation between 300-400 degrees C.
[57] EFFECTS OF PRETREATMENTS ON THE STRUCTURE OF PALLADIUM-CONTAINING AMORPHOUS ALLOYS FOLLOWED BY DSC
Varga M. Mulas G. Cocco G. Molnar A. - Journal of Thermal Analysis. 56(1):305-310, 1999
Amorphous PdZr, PdCuZr and PdCuSi alloy ribbons and powders are characterized by DSC, XRD and XPS in the as-received state and after treatments with oxygen, hydrogen or dilute hydrogen fluoride solution. Zr-containing alloys are shown to undergo substantial structural changes resulting in palladium enrichment on their surface, whereas no apparent changes in the bulk structure are found for PdCuSi. catalytic activity and selectivity of the pretreated samples were tested in the hydrogenation of phenylacetylene.
[56] MECHANOCHEMICAL SYNTHESIS AND ANODE PROPERTIES OF SNO-BASED AMORPHOUS MATERIALS
Morimoto H. Nakai M. Tatsumisago M. Minami T. - Journal of the Electrochemical Society. 146(11):3970-3973, 1999
Amorphous materials in the system SnO-B2O3-P2O5, with or without the addition of Li2O, were synthesized by mechanical milling treatment of starting oxides in a dry Nz atmosphere at room temperature. These materials, obtained as fine powders, worked as an anode for a lithium-ion secondary battery using a conventional liquid electrolyte. The first discharge capacities of the anode of SnO-B2O3-P2O5 materials obtained by mechanical milling were more than 500 mAh g(-1) at a constant current of 1.5 mA cm(-2) The capacity for Li2O added materials was comparable or slightly larger than that for the materials without the addition of Li2O. Charge-discharge curves obtained using these materials were similar to those for the glassy powders in the system SnO-B2O3-P2O5 prepared by a melt quenching procedure. SnO-based amorphous materials obtained by mechanochemical synthesis are promising candidates as high-capacity anode materials for lithium-ion secondary batteries.
[55] EFFECT OF MILLING ON THE ELECTROCHEMICAL PERFORMANCE OF NATURAL GRAPHITE AS AN ANODE MATERIAL FOR LITHIUM-ION BATTERY
Wang HY. Ikeda T. Fukuda K. Yoshio M. - Journal of Power Sources. 83(1-2):141-147, 1999
The electrochemical performance of natural graphite as the anode material for lithium-ion batteries can be improved by both jet milling and turbo milling. The effect of milling on electrochemical performance of natural graphite was

discussed in terms of morphological change in graphite. The correlations between some aspects of morphology and electrochemical performance of natural graphite were studied.

[54] SYNTHESIS AND PROPERTIES OF MAGNETS/POLYETHYLENE COMPOSITES

Cao XP. Luo YW. Feng LX. - Journal of Applied Polymer Science. 74(14):3412-3416, 1999

Polyethylene-based magnetic composites have been prepared by ethylene polymerization on the surface of NdFeB magnets, which is previously activated by ball milling with catalyst components. The level of magnets has been controlled by catalyst preparation and polymerization parameters such as Al/Ti ratio and polymerization temperature. The coertivity and the residual magnetizability were investigated. It was found that the magnetic properties of magnet powders are largely retained. In addition, in contrast to composites prepared by melt mixing, the adhesion force between magnets and polymer matrix is improved significantly and better mechanical properties are expected.

[53] A NEW MG0.9Y0.1NI HYDRIDE FORMING COMPOSITION OBTAINED BY MECHANICAL GRINDING

Lenain C. Aymard L. Dupont L. Tarascon JM. - Journal of Alloys & Compounds. 292(1-2):84-89, 1999

We report on the synthesis of an electrochemically active Mg0.9Y0.1Ni polynanocrystalline phase by mechanical alloying. This alloy presents an initial capacity of 323 mAh/g that decreases upon cycling to reach a stable value of 220 mAh/g after 30 complete charge/discharge cycles (e.g. 62% capacity retention). Such an increase in capacity retention with respect to pure MgNi alloy (62% instead of 24%) is due to the addition of yttrium that enhances the resistance of the alloy against corrosion in concentrated alkaline media.

[52] EFFECTS OF MECHANICAL GRINDING ON THE HYDROGEN STORAGE AND ELECTROCHEMICAL PROPERTIES OF LANI5

Corre S. Bououdina M. Kuriyama N. Fruchart D. Adachi G. - Journal of Alloys & Compounds. 292(1-2):166-173, 1999

LaNi5 powders were mechanically ground under argon atmosphere. After 2 h of milling, a limit particle size of 1.5 mu m was obtained. This powder was easily activated under hydrogen atmosphere and the time for a 90% maximum hydrogen uptake was found to be close to that of the unmilled powder. The first hydrogenation cycle of the milled powder shows a strong slope indicating the presence of several hydrides. The hydrogenated ground powder was stabilized with a carbon monoxide surface treatment that markedly slows down the desorption kinetics. From the ball milled and hydrogenated powder, the formation of the intermediate phase LaNi5Hx with x approximate to 3 is observed, contrarily to what is found with hydrogenated but unground powders, such a different behavior was questioned in terms of electrochemical conditions, as milled or unmilled LaNi5 powders are intensively used as the negative electrode of reversible metal hydrogen batteries. The unmilled but activated LaNi5 electrode exhibits the lowest discharge capacity but the best cycle life time (loss of only 5% of the discharge capacity after 50 cycles). The powder milled for only 1 h before activation does not present any intermediate hydride and shows a better discharge capacity. The best performance is obtained for the powder containing the intermediate phase with a discharge capacity of 307 mA h g(-1). Nevertheless, the loss in capacity after 50 cycles is large (24%).

[51] THE EFFECT OF THE THIRD-ELEMENT ADDITION ON THE FATIGUE PROPERTIES OF MECHANICALLY ALLOYED AL-TI ALLOYS

Kim BJ. Moon KI. Lee KS. - Journal of Alloys & Compounds. 292(1-2):174-180, 1999

AI-Ti-X (X=B, V, Zr, Ce) alloys were prepared by mechanical alloying and their fatigue properties were examined at room temperature, 300 degrees C and 400 degrees C. MA Al-Ti alloys showed fatigue strengths competitive with those of conventional precipitation hardened Al alloys (Al 7075, Al 2024) and the addition of third elements further improved the fatigue strength of MA alloys. As the temperature was increased to 300 degrees C and 400 degrees C, a decrease in fatigue strength was observed but the general trend in fatigue properties was the same as that at room temperature. The fatigue strength of AI-TI-X alloys, except for the Ce-added alloy, was enhanced compared with AI-Ti alloy because the third element addition reduced the lattice mismatch between Al and AI,Ti effectively and thus maintained the fine particle size of dispersoids. AI-Ti-X alloy showed the smallest precipitate size and the best room and high temperature fatigue strengths. The fatigue ratio of MA Al-Ti alloys was about 0.4 and improved slightly with temperature. The fracture mode of MA Al-Ti alloys was thought to be intergranular failures, in some cases involving also the interface between the matrix and the dispersoids.

[50] INVESTIGATION ON THE SYNTHESIS, CHARACTERIZATION AND HYDROGENATION BEHAVIOUR OF NEW MG-BASED COMPOSITE MATERIALS MG-X WT.% MMNI(4.6)FE(0.4) PREPARED THROUGH MECHANICAL ALLOYING

Davidson DJ. Raman SSS. Srivastava ON. - Journal of Alloys & Compounds. 292(1-2):194-201, 1999

Alloys with general formula Mg-x wt.% MmNi(4.6)Fe(0.4) have been successfully synthesized through ball milling employing a high energy attritor mill. The ball milling has been done in hexane medium; various time durations and speeds (rev./min) have been employed. The hydrogenation and dehydrogenation behaviour of these new composite materials have been extensively investigated. The as-prepared (ball milled: mechanically alloyed) composite materials have been activated at 400 +/- 10 degrees C under a hydrogen pressure of similar to 40 kg cm(-2). These composite materials have been found to possess one of the highest known storage capacities. It has been found that the highest storage capacity material (similar to 5.0 wt.% at 350 degrees C) corresponds to Mg-30 wt.% MmNi(4.6)Fe(0.4). The said alloy exhibits fast absorption-desorption kinetics (about 80 cm(3) min(-1)). It is also established that the optimum mechanically alloyed samples for hydrogen storage were obtained with milling at 400 rev./min speed and time duration of similar to 5 h. The hydriding rate and the improved hydrogen storage capacity of these composite materials have been found to be strongly correlated with the structural and microstructural characteristics as brought out through XRD and SEM techniques. For example, the ball milled samples having optimum hydrogenation characteristics exhibited highly uniform particle size distribution.

[49] ON THE SYNTHESIS, CHARACTERIZATION AND HYDROGENATION BEHAVIOUR OF MG-BASED COMPOSITE MATERIALS MG-X WT.% CFMMNI(5) PREPARED THROUGH MECHANICAL ALLOYING

Raman SSS. Davidson DJ. Srivastava ON. - Journal of Alloys & Compounds. 292(1-2):202-211, 1999

The present study deals with the investigations on the synthesis, structural/microstructural characteristics and

hydrogenation/ dehydrogenation behaviour of Mg-bearing composite materials Mg-x wt.% CFMmNi(5) prepared through mechanical alloying. The composite materials Mg-x wt.% CFMmNi(5) have been successfully synthesized through ball-milling (mechanical alloying) by employing a high energy attritor mill. The mechanical alloying has been carried out in hexane medium by varying the milling parameters say, speed (revolutions per minute) and milling duration. The as-milled composite materials have been activated at 400+/-10 degrees C under a hydrogen pressure of similar to 35-40 kg cm(-2). These composite materials exhibit high hydrogen storage capacity and fast absorption/desorption kinetics in comparison to the thermally melted counterparts. It has been found that the highest storage capacity material (similar to 5.4 wt.% at 350 degrees C) corresponds to Mg-30 wt.% CFMmNi(5). The composite material also exhibits fast desorption kinetics (about 90 cm(3) min(-1)), which is at least two times faster than conventionally prepared (RF melting) alloys. The highest hydrogen storage capacity and fast kinetics were obtained for the mechanically alloyed samples with the optimized milling conditions, i.e. speed similar to 400 rev min(-1) and lime duration of 5 h. The hydriding rate and the improved hydrogen storage capacity of these composite materials have been found to be strongly correlated with Structural and microstructural characteristics as brought out through XRD and SEM techniques. The uniform particle size distribution and interfacial grain boundaries explored from the SEM investigations paves the way for better hydrogen storage capacity and fast absorption and desorption kinetics.

[48] INFLUENCE OF NITROGENATION ON STRUCTURE DEVELOPMENT AND MAGNETIC PROPERTIES OF MECHANICALLY ALLOYED AND ANNEALED SM-FE POWDERS

Teresiak A. Kubis M. Mattern N. Wolf M. Gruner W. Muller KH. - Journal of Alloys & Compounds. 292(1-2):212-220, 1999

Sm-Fe-N compounds were prepared by mechanical alloying, subsequent annealing and nitrogenation. For crystal structure investigations of the non-equilibrium phases Sm2Fe17+yNx, formed at various annealing temperatures T-A for 1 h, X-ray diffraction with following Rietveld analysis was used. A volume expansion of 6.2% was observed after nitrogenation, As for the non-nitrided Sm-Fe alloys a modified TbCu7-type structure (space group P6/mmm) and a modified Th2Zn17-type structure (space group R (3) over bar m) have been observed. However, for nitrogenated Sm-Fe samples the modified Th2Zn17-type structure forms already for annealing at T-A=750 degrees C prior to nitrogenation. For samples annealed, prior to nitrogenation, between T-A=600 and 700 degrees C the modified TbCu7-type structure was found, in which the nitrogen occupies randomly the 3f position with an occupancy larger than 1/3. The partially ordered, modified Th2Zn17-type structure formed for 750 degrees C <T-A<900 degrees C, is derived from the ideal Th2Zn17-type structure by introducing additional Fe(6c) and Sm(Sa) positions. The degree of order of the Sm atoms and Fe-dumbbells increases with increasing T-A. The nitrogen occupies the octahedral interstitial positions 9e in the latter cases. The nitrogen content is higher in the hexagonal phase than in the rhombohedral phase. Optimum magnetic properties were obtained for T-A=750 degrees C. Here we found a coercivity mu(0J)H(c)=3.7 T and a good squareness of the demagnetization curve.

[47] CATALYTIC EFFECT OF TRANSITION METALS ON HYDROGEN SORPTION IN NANOCRYSTALLINE BALL MILLED MGH2-TM (TM=TI, V, MN, FE AND NI) SYSTEMS

Liang G. Huot J. Boily S. Van Neste A. Schulz R. - Journal of Alloys & Compounds. 292(1-2):247-252, 1999

Intensive mechanical milling was used to make MgH2-Tm (Tm=3d-transition elements Ti, V, Mn, Fe, Ni) nanocomposite powders. The hydrogen storage properties of these composite powders were evaluated. The five Sd-elements Ti, V, Mn. Fe and Ni showed different catalytic effects on the reaction kinetics of Mg-H system. Desorption was most rapid for MgH2-V, followed by MgH2-Ti, hgH(2)-Fe, MgH2-Ni and MgH2-Mn at low temperatures. The composites containing Ti exhibited the most rapid absorption kinetics, followed in order by Mg-V, Mg-Fe, Mg-Mn and Mg-Ni. Formation enthalpy and entropy of magnesium hydride were not altered by milling with transition metals, while the activation energy of desorption for magnesium hydride was reduced drastically.

[46] THE ACTIVATION CHARACTERISTICS OF A ZR-BASED HYDROGEN STORAGE ALLOY ELECTRODE SURFACE-MODIFIED BY BALL-MILLING PROCESS

Lee SM. Lee H. Yu JS. Fateev GA. Lee JY. - Journal of Alloys & Compounds. 292(1-2):258-265, 1999

In order to improve the activation properties of the Zr-based hydrogen storage alloy electrode, the ball-milling process is applied to the Zr-based alloy using the Ti-based alloy powder as a surface modifier. While the Zr-based alloy electrode is not fully activated before 50 cycles, the bah-milled Zr-based alloy electrode using Ti-based alloy as a surface modifier is fully activated within only 4 cycles. In order to analyze the strikingly improved activation characteristics after ball-milling, the microstructure of ball-milled alloy is examined by TEM, SEM and EDS. It is observed that there is a surface alloying region at the contact points between the two alloy powders from the TEM bright-field image. Furthermore. the local quantitative analysis by EDS clearly reveals that the atomic concentration of the constituting elements in the surface alloying region is gradually changed between the two alloy powders. From the above results, it is suggested that the high kinetic energy applied in the ball-milling process causes cold-welding or surface alloying at the points of impact where Zr-based alloy particles collide with Ti-based alloy particles by the action of steel balls at high speed. The SEM analysis demonstrates that the particle size is decreased as the ball-milling time increases, which implies an increase in the surface area of Zr-based alloy particles touching Ti-based alloy particles. Eventually, it can be suggested that Ti-alloy powder serves as a window for hydrogen to penetrate into the Zr-based alloy, which lends to easy absorption-desorption of hydrogen and also to improvement in the activation properties of the Zr-based alloy electrode.

[45] NEUTRON DIFFRACTION STUDY OF LIXIVIATED NANOCRYSTALLINE MG-LI COMPOUND

Huot J. Swainson IP. Schulz R. - Journal of Alloys & Compounds. 292(1-2):292-295, 1999

The ball milled nanocrystalline Mg72Li28 compound before and after lixiviation in water was investigated by neutron and X-ray scattering. The specific surface area before and after treatment was precisely measured. The crystallographic parameters were extracted by Rietveld refinement. It was found that with energetic ball milling, the solubility limit of magnesium in lithium was slightly increased. By lixiviation. all Lithium was leached. In order to reduce the amount of metal oxides and hydroxides, the conditions of lixiviation have to be optimized.

[44] STRUCTURAL AND SURFACE CHARACTERIZATIONS OF NANOCRYSTALLINE PT-RU ALLOYS PREPARED BY HIGH-ENERGY BALL-MILLING

Lalande G. Denis MC. Guay D. Dodelet JP. Schulz R. - Journal of Alloys & Compounds. 292(1-2):301-310, 1999

The bulk and surface characteristics of Pt-Ru alloys prepared by high-energy ball-milling were studied over the whole compositional range. These materials were prepared in their as-milled and Mg-dispersed forms. The latter form is obtained by milling Mg with nanocrystalline Pt-Ru alloy prepared in a first step and then leaching out Mg in an acidic solution. The structure of the various alloys was determined by X-my diffraction.. Quantitative structural information was extracted from the X-ray histograms through Rietveld refinement analysis. In the as-milled form, a nanocrystalline fee or a hcp structure is obtained after milling (40 h) of an initial powder mixture whose composition falls into the Pt- or Ru-rich side of the compositional range, respectively. For mixtures whose composition falls into the immiscibility gap, a metastable amorphous phase is formed. which co-exists with a fee or a hcp structure, depending on which side of the immiscibility gap the composition is. The structure of Mg-dispersed Pt-Ru alloys is identical to that of the as-milled materials. The chemical composition and structure of the alloy surface was determined by X-ray photoelectron spectroscopy. From measurements of the Ru 3p and Pt 4f core level peaks, it is shown that the surface composition of both as-milled and Mg-dispersed alloys closely follow their bulk composition, with only a slight enrichment in Pt. There is also no change in the surface composition resulting from the extra milling step with Men and its subsequent leaching. The separation between the maximum of the Ru 3d(5/2) and Pt 4f(7/2) core level peaks varies with the composition of the alloy, indicating that a true surface alloy is formed between Pt and Ru.

[43] HYDROGEN IN THE MECHANICALLY PREPARED NANOSTRUCTURED GRAPHITE

Orimo S. Majer G. Fukunaga T. Zuttel A. Schlapbach L. Fujii H. - Applied Physics Letters. 75(20):3093-3095, 1999

Nanostructured graphite was prepared by mechanical milling under hydrogen atmosphere. Several samples obtained after different milling times were systematically examined to get fundamental information about the structures and hydrogen concentrations. After the expansion of the graphite interlayer, the long-range ordering of the interlayer disappears continuously with increasing milling time. The hydrogen concentration reaches up to 7.4 mass % (CH0.95) after milling for 80 h. Judging from the radial distribution function determined by the neutron diffraction measurement, there are two types of deuterium coordinations: deuterium atoms in the graphite interlayers and that with the CDx covalent bonds, respectively.

[42] MECHANOCHEMICAL REACTION AND FORMATION OF AN AMORPHOUS NITRIDE PHASE DURING BALL MILLING OF SI IN NH3

Li ZL. Williams JS. Llewellyn DJ. Giersig M. - Applied Physics Letters. 75(20):3111-3113, 1999

The formation of an amorphous SixNyH phase is obtained by a solid-gas mechanochemical reaction induced by ball milling of Si in NH3 gas. We suggest that mechanical damage together with absorbed N and H play an important role in the formation and stability of the amorphous SixNyH phase during milling. Transmission electron microscopy, x-ray diffraction, thermal analysis, and composition analysis have been used to characterize the samples after ball milling and subsequent annealing. Crystallization of the amorphous phase to alpha-Si3N4 is observed at temperatures above 800 degrees C.

[41] HIGH COERCIVITY IN NANOSTRUCTURED PRCO5-BASED POWDERS PRODUCED BY MECHANICAL MILLING AND SUBSEQUENT ANNEALING

Chen ZM. Meng-Burany X. Hadjipanayis GC. - Applied Physics Letters. 75(20):3165-3167, 1999

anostructured PrCo5-based PrxCo100-x (x = 15.4-20.5) powders have been synthesized by mechanical milling and subsequent annealing cast alloys. The best overall properties have been developed in stoichiometric PrCo5 powders milled for 4 h and annealed at 800 degrees C for 1 min with a high coercivity of 16.3 kOe along with a high M-r/M-s ratio of 0.66 and medium-strength maximum-energy product of 11.6 MGOe. The highest coercivity of 23.7 kOe has been obtained in Pr19Co81 powders. Microstructural studies reveal that a uniform PrCo5 microstructure with an average grain size of about 15 nm is developed in the powders, which have an average particle size of about 5 mu m. The observed magnetic hardening is believed to arise from the high anisotropy field of the PrCo5 phase and the uniform nanoscale microstructure developed by the processing used.

[40] MAGNESIUM-BASED HYDROGEN STORAGE MATERIALS MODIFIED BY MECHANICAL ALLOYING

Cui N. He P. Luo JL. - Acta Materialia. 47(14):3737-3743, 1999

The effects of mechanical alloying on microstructure and electrochemical performance of a Mg-Ni-Y-Al hydrogen storage alloy in 6 M KOH solution were studied. The bah-milled powders were examined by X-ray diffraction (XRD), transmission electron microscopy (TEM), selected-area electron diffraction (SED) and energy dispersion spectrometry (EDS). TEM and EDS results clearly reveal that the smaller nickel clusters or particles were well dispersed on the surface of larger magnesium alloy particles by mechanical grinding for 72 h. With an increase in milling time to 240 h, the nickel clusters or particles disappeared and a new monophase alloy with amorphous structure was formed. The electrochemical capacity of the modified material significantly increased with increasing milling time within 72 h and then dropped to nearly nil when the milling time reached 240 h. The capacity decay, however, was always improved with increasing grinding time. Further analysis and discussion were made based on d.c, polarization and a.c. impedance spectroscopy measurement results.

[39] COATING TECHNIQUE OF INTERMETALLIC POWDERS NIAL BY CERAMIC POWDERS ZRO2-8% Y2O3 [FRENCH]

Ouchetto M. Chouiyakh A. - Revue de Metallurgie-Cahiers d Informations Techniques. 96(9):1115-1119, 1999

A new technique for coating intermetallic powders by ceramic powders has been developed in laboratory It has been drawn from mechanical alloying. Its principle consists to applied on the powders a strong compression forces, by hammers against inner side of the chamber's wall, attrition and shear forces. The forces engender heat which is therefore responsible for welding of the two types of powders. This technique has been perfected to avoid grinding and the contamination of powders by apparatus components. The main part of this apparatus is constituted by a

cylindrical chamber 47 mm in height and 100 mm in diameter, inside of which there is a static circular piece. The piece is composed of two hammers and two scrapers of 44 in height, placed symmetrically to each others (fig. 1). The assembly is placed on a rotating plateau. The intermetallic NiAl (diameter < 45 mu m) (fig. 2) and ceramic powders ZrO2 (diameter < 0,6 mu m) are introduced, in appropriate proportion, inside the cylindrical chamber. The system is subsequently set in motion. As a result of centrifugal forces, the powders are compressed whilst passing through the remaining space between the inner side of the chamber's wall and the hammers. The friction forces originate heat which is therefore responsible for the adhesion of the types of powders forming cermet. The present work has focused on the investigation of two parameters. The first parameter consists of varying the time of the powders stays inside the rotating cylindrical chamber. The space between the chamber's wall and the hammers, on one hand, and scrapers on the other hand, were adjusted to one millimeter. The chamber was first fumed on during two hours, in order to make the new surfaces, in their nascent state, are susceptible to forces of adhesion. The surfaces so achieved allow improved adherence among particles of a different nature. Afterwards, the ceramics powders (12 % wt) were added gradually to avoid any agglomeration. Later on, the time of rotation was extended up to 55 h. The results of Scanning Electron Microscopy, after 8 h of rotation, have revealed the existence of small NiAl particles deriving from a partial reduction of initial size. The micrographs of cross sections show that those having a large diameter are covered partially by a fine layer of ZrO2 (fig. 3) whereas the small ones (diameter less than 10 mu m) are completely coated by ZrO2 (fig. 4a). The particles of different natures are joined to each other because of strong compression. It has been noted that after 15 h of rotation, the micrographies depict a considerable reduction on NiAl particles sizes down to 5 mu m. Such a reduction is likely due to strong compression. The powder compression generates strong friction forces which lead the temperature rising up to 200 degrees C inside the chamber. The cross section of small particles (diameter < 10 mu m), exhibit a second type of the particles; a major constituent of the core are Zr and Al, however, the surface composition is mainly Ni (fig. 4b). After 55 h, the majority of the particles are spherical and become completely covered by other microparticles, all of which seem to be welded on the surface (fig. 5). The analysis shows that these microparticles are compounded by Al, Ni and Zr. The second part of this work deals with the effect of the initial powders compositions on the quality of coating. In this case we have increased the remaining space between the hammers and the inner side of the chamber up to 2 mm in order to avoid the reduction of NiAl particles sizes; as it has already been noted in the first part. The variation of the compositions, from 12 to 40 in weight percent of ZrO2, was associated with an increase in the quality of the coating. The thickness of ZrO2 layer varies from a few hundred of manometer for 12 % wt to 7 mu m for 40 % wt (fig. 6). It has been concluded that the new process is well adapted in coating the intermetallic powder by ceramic ones. It makes to obtain an even ceramic layer of several micrometers in thickness during an experiment less than 8 hour's and with a 2 mm between hammers and the chamber wall. The coating powders were then annealed or used in plasma spraying experiments. The use of coated particles ensure better homogeneity of deposits than projection performed with uncoated powders.

[38] EFFECT OF MECHANICAL ALLOYING ON SELECTIVE LASER SINTERING OF WC-9CO POWDER

Laoui T. Froyen L. Kruth JP. - Powder Metallurgy. 42(3):203-205, 1999.

Experiments on the laser sintering of single two-dimensional hardmetal powder layers have been conducted in an attempt to identify optimum powder properties and laser parameters. Use of mechanical alloyed powders was found to improve the density and surface finish of sintered layers relative to the properties obtained by Turbula mixed powders. Methods of improving the packing density of the, powder layer will be desirable to further the development of effective rapid prototyping.

[37] FORMATION OF NANOMETRIC HARD MATERIALS BY COLD MILLING

Welham NJ. Llewellyn DJ. - Journal of the European Ceramic Society. 19(16):2833-2841, 1999

The fabrication of nanosized, single crystal TiC or TiN powders from ilmenite or TiO2 within a single low temperature stage is reported in this paper. The titaniferous powders were ball milled for 100 h in a laboratory scale mill with magnesium powder and either graphite or nitrogen. The resultant powders were then subjected to an annealing step at 1200 degrees C. Differential thermal analysis and X-ray diffraction showed that the phases formed within the milling step and underwent grain growth on annealing. Acid leaching of the powders selectively removed the unwanted product phases leaving only the hard material. The final particle size and Scherrer XRD crystallite size were similar after annealing, implying that the particles produced were single crystal.

[36] EFFECT OF COMPOSITIONAL VARIATION AND FINENESS ON THE DENSIFICATION OF MGO-AL2O3 COMPACTS

Sarkar R. Banerjee G. - Journal of the European Ceramic Society. 19(16):2893-2899, 1999

Single stage densification of magnesia-alumina compacts were studied with MgO to Al2O3 molar ratios 1:1 (stoichiometric spinel), 2:1 (magnesia rich spinel) and 1,2 (alumina rich spinel). Attritor milling has been adopted to produce variation in fineness. Milling greatly improved the densification. Densification was found to be easier for the magnesia rich composition and difficult for the alumina rich one. Xray diffraction patterns showed the expected phases in stoichiometric and magnesia rich spinel. Alumina rich composition showed no free corundum phase on sintering at 1650 degrees C and only spinel phase marks the complete solid solution of excess alumina in spinel at this composition. EDAX analysis also supports the event and also reflects that the impurities are mainly present at the grain boundaries.

[35] GRAIN CORE STUDY OF FE1-XCRX NANOGRAINS OBTAINED BY MECHANICAL ALLOYING

Lemoine C. Fnidiki A. Lemarchand D. Teillet J. - Journal of Physics-Condensed Matter. 11(42):8341-8350, 1999

Mechanical alloying (MA) of Fe1-xCrx powder mixtures was performed over a wide range of concentration. Both x-ray diffraction and TEM analyses show that, after 30 hours of milling, the powder particles consist of nanocrystalline grains less than 10 nm in size. The kinetics of mixing is studied by Mossbauer spectrometry. This is the first time that the FeCr mixing state has been studied as a function of the milling conditions and the initial powder composition. This mixing state is defined by a parameter (d) calculated from the hyperfine field values. The alloying process is weakly composition dependent(for x less than or equal to 40 at.% Cr), but is linked to the energy input to the powder. Especially an energy threshold must be transferred to the powder to reach a complete alloying. By studying the

hyperfine field distributions of the Mossbauer spectra (for Cr < 40 at.%), it seems that the Fe1-xCrx nanograin cores are quite homogeneous in composition and have hyperfine parameters close to those of the bulk alloys.

[34] AN ALLOTROPIC TRANSFORMATION INDUCED BY MECHANICAL ALLOYING

Chatterjee PP. Pabi SK. Manna I. - Journal of Applied Physics. 86(10):5912-5914, 1999

This study concerns a hitherto unknown bcc --> fcc allotropic transformation in Nb induced by the mechanical alloying of Nb80Al20. This metastable transformation is preceded by a gradual increase in the lattice parameter of bcc-Nb. The stored excess energy in nanocrystalline bcc-Nb may be responsible for the bcc --> fcc phase transition.

[33] HIGH-ENERGY CRYOGENIC BLENDING AND COMPATIBILIZING OF IMMISCIBLE POLYMERS

Smith A. Spontak RJ. Ade H. Smith SD. Koch CC. - Advanced Materials. 11(15):1277-+, 1999

Communication: Low-temperature mechanical alloying of immiscible polymers is investigated as a viable solid-state alternative to blending using melt or solution processes. The Figure is a schematic diagram of the alloying-or high-energy ball-milling-process. indicating that reactive chain coupling may occur in the event of free-radical generation due to chain scission.

[32] THE STUDY OF NANO-CRYSTALLIZATION OF FE73.5CU1NB3B9SI13.5 AMORPHOUS ALLOY UNDER SHOCK WAVE [CHINESE]

Zhou XF. Liu YK. Liu ZQ. Li DX. -Acta Physica Sinica. 48(11):2098-2103, 1999

Non-crystalline alloys can be turned into nano-crystalline under shock waves. This has been proved by our experiments. Recently, we have discovered that the functions of Cu and Nb of Fe73.5Cu1Nb3B9Si13.5 in shock wave crystallization are restrained, and the size of crystallites in the crystallized alloy Fe73.5Cu1Nb3B9Si13.5 is increased and its lattice constant is decreased after the sample is annealed again. These phenomena are worth to study further. The model of fluid-change for explaining the law of shock wave crystallization is suggested in this paper.

[31] THE PREPARATION AND THE PROPERTIES OF MICROCRYSTALLINE AND NANOCRYSTALLINE CUCR CONTACT MATERIALS

Wang YP. Ding BJ. - IEEE Transactions on Components & Packaging Technologies. 22(3):467-472, 1999

The microcrystalline and nanocrystalline CuCr alloys prepared by high-energy ball milling and hot pressing were investigated in this paper. The experimental results show that the nanocrystalline Cu-Cr alloy powders are obtained by high energy ball milling, and the milled powders appear flaked or equiaxed morphology with or without liquid medium addition. The grain size of near fully dense alloys consolidated at 850 and 1200 K from milled powders is less than 100 nm and about 2-3 mu m, respectively. The ability to withstand high voltage of the nanocrystalline CuCr materials in vacuum is much higher than that of microcrystalline materials. The breakdown first takes place on the Cu-rich phase in the microcrystalline CuCr materials. For nanocrystalline CuCr materials, the breakdown exhibits diffusional feature, in which the are can move to the whole contact surface in a breakdown.

[30] HIGH TEMPERATURE OXIDATION OF AN OXIDE-DISPERSION STRENGTHENED NIAL

Lee WW. Lee DB. Kim MH. Ur SC. - Intermetallics. 7(12):1361-1366, 1999

The oxidation behavior of an oxide-dispersion strengthened (ODS) NiAl has been studied between 900 and 1100 degrees C in air. The dispersoids of mostly Al2O3 in fine-grained beta-NiAl were incorporated by mechanical alloying (MA) in an argon atmosphere and hot pressing. It was found that excessive amounts of dispersoids and voids within the matrix had serious negative effects on the oxidation resistance of beta-NiAl, by allowing for a more rapid formation of oxide scales and by providing fast diffusion paths for oxygen. Below the thin surface oxide scales consisted of alpha-Al2O3, NiAl2O4 and Ni2O3, an internal oxidation zone was formed deep into the matrix. No metastable transient aluminas were formed during oxidation. The oxide ridge structure began to evolve after oxidation at 1100 degrees C at the oxide-gas interface.

[29] EFFECT OF HEAT-TREATMENT ON RESIDUAL STRAIN IN L1(2)-(ALMN)(3)TI(V) ALLOY POWDERS [JAPANESE]

Kasahara K. Hashimoto K. Kimura T. Yamamoto Y. - J. the Japan Institute of Metals. 63(9):1129-1132, 1999

To evaluate the effect of heat-treatment and vanadium addition on the microstructure and the room-temperature ductility of the L1(2)-type (AlMn)(3)Ti titanium trialuminides alloy, the alloys with addition of vanadium up to 6 mol% were homogenized in a temperature range of 1450 similar to 1530 K for a time less than 259.2 ks. The microstructure characterizations were performed by using the laser optical microscopy, scanning electron microscopy and X-ray diffraction. The residual strain which was induced during the milling of the L1(2) single-phase alloys into powder specimens was determined form X-ray diffraction peak profiles. All of the alloys exhibit a single-phase microstructure containing only the L1(2) phase, irrespective of the homogenization condition. These alloys also exhibit a small amount (0.1 similar to 1.0% in area) of porosity which decreased with increasing vanadium content and the amount of porosity was independent of the homogenization temperature. A relatively large residual strain was obtained from the alloy with higher vanadium content, while the residual strain has shown a small change depending on the homogenization temperature. These results suggest that the effect of heat-treatment on microstructure and room-temperature ductility is not so remarkable as those of the change of alloy compositon.

[28] PREPARATION OF MG2SI-FESI2 THERMOELECTRIC DEVICE BY MA-PULSED CURRENT SINTERING PROCESS [JAPANESE]

Sugiyama A. Kobayashi K. Matsumoto A. Ozaki K. Nishio T. - Journal of the Japan Institute of Metals. 63(9):1145-1148, 1999

The formation process and Seebeck coefficient of a Mg2Si-FeSi2 thermoelectric device made by mechanical alloying (MA) and pulsed current sintering was investigated. The MA was performed in a planetary ball mill using three elemental powders. The powders were prepared by the mixing of Mg2Si-xmass%FeSi2 (x=0, 20, 40, 60, 80, 100). The MA powders were consolidated by pulsed current sintering method. The Seebeck coefficient of Mg,Si sintered at 823 K under 350 MPa was -366 mu V/K at room temperature. However, the Seebeck coefficient of Co doped FeSi2 sintered at 1073 K was 4 mu V/K because the sintered structure of FeSi2 was consisted of alpha and epsilon phase. After heat treatment at 973 K for 108 ks, the structure of FeSi2 became almost pure beta phase and the Seebeck coefficient became -245 mu V/K. Mg2Si-80 mass% FeSi2 was held at 823 K for 180 s and at 1073 K for 600 s during

pulsed current sintering, in order to attain the densification. After sintering, the sample was heat treated at 973 K for 108 ks. Therefore, Mg2Si phase and beta-FeSi2 phase coexisted in the sample. However, the Seebeck coefficient of Mg2Si-80 mass%FeSi2 was about -110 mu V/K. There was no improvement of the Seebeck effect.

[27] PULSED CURRENT SINTERING OF MECHANICALLY ALLOYED NI-TI POWDER [JAPANESE]

Kobayashi K. Matsumoto A. Ozaki K. Sugiyama A. Nishio T. - Journal of the Japan Institute of Metals. 63(9):1161-1164, 1999

In order to fabricate the compacts with complicated shape, Ni-Ti powders were synthesized by mechanical alloying(MA) and consolidated by pulsed current sintering. Ni-50 at%Ti powders were synthesized by MA of pure elemental Ni and Ti powders using a planetary ball milling for 180 ks, 360 ks and 540 ks. The X-ray diffraction profile of the obtained MA powders contained a broad peak. MA powders milled for 180 ks and 360 ks consisted of fine Ni and Ti grains and melted at about 1150 K by self-propagating high-temperature synthesis (SHS) during pulsed current sintering. The MA powder milled for 540 ks contained a large amount of Fe. This is because NiTi phase was produced by SHS during the MA process. The addition of 2 at%B to the starting powders of the MA was prevented a SHS reaction during pulsed current sintering. Ni-49 at%Ti-2 at%B powders synthesized by MA were consolidated to compacts with complicated shapes by pulsed current sintering. The obtained compacts consisted of NiTi, Ti2Ni, Ni3Ti and TiB2 phases. The result of differential scanning calorimetry measurement for the compacts heat-treated at 673 K for 3.6 ks suggested that those possessed shape memory effects.

[26] STRUCTURAL EVOLUTION OF FULLERENE DURING MECHANICAL MILLING

Liu ZG. Ohi H. Tsuchiya K. Umemoto M. Masuyama K. - Journal of Materials Science & Technology. 15(5):405-409, 1999

Mechanical milling of fullerene (C-60(C-70)) was investigated to understand the structural evolution. Mechanical milling could not destroy the molecular structure of C-60(C-70), while the long range periodicity of the fee crystalline structure was easily damaged. Longer milling time could result in the formation of C-60(C-70) polymer, including C-60 dimer.

[25] PHASE STRUCTURE CHANGE OF MO-SI SYSTEM DURING MECHANICAL ALLOYING

Liu SJ. Qu XH. Liu ZJ. Huang BY. - Source Journal of Materials Science & Technology. 15(5):423-426, 1999

The structure of Mo-15.16 Si, Mo-30 Si and Mo-36.3 Si (wt pct) elemental powder mixture during mechanical alloying was studied using electron microscopy and X-ray diffraction. It had been found that, in all the systems under study, silicon disappeared initially during mechanical alloying (MA). In the Mo-Si systems all products were in form of amorphous state after long time milling, but there were different intermediate products. MoSi2 and Mo5Si3 intermetallic compounds in the Mo-30Si and Mo-36.3Si (wt pct) were directly synthesized from elements through inter-diffussion process. The high density of defects and interface of nano-crystal lines induced by ball milling would promote the reaction process. Only in the Mo-15.16Si (wt pct) system was Mo(Si) supersaturated solid solution formed as an intermediate product. Schematic free-energy diagram of Mo-Si system based on the thermodynamics was used to analyze the difference among the intermediate state products.

[24] PRELIMINARY INVESTIGATION OF NIAL-TIB2 COMPOSITE PREPARED BY REACTION MILLING

Zhou LZ. Guo JT. - Journal of Materials Science & Technology. 15(5):427-430, 1999

Reaction-milled NiAl-TiB2 composite was fabricated by mechanical alloying elemental powders and hot pressing. TiB2 particles are distributed mostly in grain boundaries of the matrix. The compressive strain to failure of the composite at RT is about twice that of cast NiAl. The compressive yield stress at high temperatures is about 4.5 times higher than that of extruded NiAl, and is also much stronger than XD NiAl-TiB2 composites. Deformation behavior between 1000 similar to 1100 degrees C with different strain rates has been investigated.

[23] Wear behaviour of aluminum reinforced with nickel aluminide MMCs

da Costa CE. Zapata WC. Velasco F. Ruiz-Prieto JM. Torralba JM. - Journal of Materials Processing Technology. 93:66-70, 1999

In this work, the wear behaviour of different aluminum matrix composites reinforced with Ni aluminides was evaluated. The composite materials were obtained through P/M routes using different techniques: mechanical alloying, gas atomizing, cold compaction and hot extrusion. Aluminum matrix powders were alloyed mechanically, the aluminides used for reinforcing the matrix being: (i) those obtained through gas atomizing; or (ii) those generated 'in situ' through nickel additions. Once the materials were mixed and cold compacted, the specimens were hot extruded and heat treated (T6 treatment). Wear tests were performed in both as-extruded and heat-treated conditions, using a 'pin, on disk' apparatus. The wear test variables were: the alumina counterpart (a ball of 6 mm diameter); environmental humidity lower than 30%; a track length of 1000 m; and a speed of 0.1 m/s. The friction coefficient was measured for all the materials and the, wear behaviour determined through the volume loss of the disk. A complete metallographical study was done using scanning electron microscopy. The main advantage from the industrial point of view is the uncanned extrusion process that enables advance materials to be obtained by low cost processing. In this way, materials can be obtained with improved wear and mechanical properties at relatively low cost.

[22] CHARACTERIZATION OF MECHANICALLY ALLOYED FE-CR-SN ALLOYS

Costa BFO. Le Caer G. Begin-Colin S. Mendes PJ. de Campos NA. - Journal of Materials Processing Technology. 93:395-400, 1999

Ferritic steels with high Cr concentration are extensively used due to their resistance to corrosion, also they are much cheaper to produce than Ni alloys and austenitic stainless steels. However, the formation of the sigma phase and phase separation affect their mechanical properties deleteriously. The addition of Sn to the Fe-Cr system retards the sigma phase formation. Their mechanical properties may be further improved by decreasing the average grain size and the density of defects inside the grains, as in nano-grained Fe-Cr alloys. Nanocrystaline Fe-Cr-Sn alloys, which are prepared by mechanical alloying, are thus, worthy of investigation. In this work mechanical alloying of mixtures of elemental Fe, Cr and Sn powders was carried out in an Ar atmosphere using either untreated or hardened vials and balls, in order to obtain the following alloys: Fe55-xCr45Snx with x = 0, 3 and 6 at%. These were studied by Fe-57

Mossbauer spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM) and differential scanning calorimetry (DSC). It was found that the increasing of the Sn concentration leads to a reduction of particle size and grain size. Furthermore, milling in the untreated vials causes a partial amorphization of the alloys. Contamination from the balls and vials decreases with the increasing Sn concentration.

[21] ATOMIC STRUCTURE AND MAGNETIC PROPERTIES OF CU80CO20 NANOCRYSTALLINE COMPOUND PRODUCED BY MECHANICAL ALLOYING

Ivchenko VA. Uimin MA. Yermakov AY. Korobeinikov AY. - Surface Science. 440(3):420-428, 1999

Direct observation of the atomic structure of the mechanically alloyed Cu80Co20 compounds has been made using the field ion microscope (FIM). Phase composition, defect structure and morphology of material on the atomic scale have been determined. It has been established that the studied material is chemically inhomogeneous, presenting a mixture of two main phases: heterogeneous solid solution of cobalt in copper, and pure cobalt. Phase volume ratios, particle and cluster sizes have been estimated. An evaluation of Co content in Cu-Co solid solution has been made. The width of interfaces in this mechanically alloyed material was revealed to be at least twice the width of phase boundaries in metals and alloys. Superparamagnetism of the compound studied at elevated temperatures and saturation magnetization deficit at low temperatures are discussed on the basis of the above-mentioned structural data.

[20] MECHANICAL ALLOYING OF TI-NI ALLOYS UNDER HIGH PRESSURE

Dobromyslov AV. Churbaev RV. Elkin VA. Trenogina TL. - Scripta Materialia. 41(9):1015-1021, 1999

[19] AQUEOUS SOLUBILIZATION OF CRYSTALLINE FULLERENES BY SUPRAMOLECULAR COMPLEXATION WITH GAMMA-CYCLODEXTRIN AND SULFOCALIX[8]ARENE UNDER MECHANOCHEMICAL HIGH-SPEED VIBRATION MILLING

Komatsu K. Fujiwara K. Murata Y. Braun T. - Journal of the Chemical Society. Perkin Transactions 1. (20):2963-2966, 1999

The solid-state supramolecular complexation of fullerenes C-60 and C-70 as well as some derivatives of C-60 was attained with gamma-cyclodextrin by the use of a mechanochemical high-speed vibration milling technique. Similarly C-60 and the fullerene dimer C-120 were complexed with sulfocalix[8]arene. The complexes produced were found to be soluble in water, and their solubility was examined by UV-vis spectroscopy.

[18] BISMUTH SILICON OXIDE (BI12SIO20-BSO) AND BISMUTH TITANIUM OXIDE (BI12TIO20-BTO) OBTAINED BY MECHANICAL ALLOYING

Vasconcelos IF. De Figueiredo RS. De Lima SJG. Sombra ASB. - Journal of Materials Science Letters. 18(22):1871-1874, 1999

[17] STRUCTURAL COMPARISON BETWEEN THE GAMMA(2)-FEZN4 COMPOUND OBTAINED BY MECHANICAL ALLOYING AND THE GAMMA(2)-FE6NI5ZN89 GALVANIZING DROSS

Reumont G. De Figueiredo RS. Foct J. - Journal of Materials Science Letters. 18(22):1879-1882, 1999

[16] DIRECT FORMATION OF NANO-SIZED PBTIO3 POWDERS BY HIGH ENERGY BALL MILLING

Kong LB. Zhu WG. Tan OK. - Ferroelectrics. 230(1-4):583-588, 1999.

Nano-sized PbTiO3 powders have been successfully synthesized using the high energy ball milling technique. The materials used are PbO and TiO2 Anatase and Rutile powders. The powders milled for different hours are characterized using XRD and TEM. Experimental results show that the single perovskite phase of PbTiO3 can be readily formed by the high energy ball milling process without any post-annealing, indicating that nano-sized PbTiO3 can be obtained using a simple, low-cost, room temperature processing technique which is free of volatility of lead. The relationship between the microstructure of the synthesized PbTiO3 powders and milling hours is also discussed.

[15] EVIDENCE OF MECHANICAL ALLOYING IN BALL MILLED ZRO2-Y2O3 SYSTEM BASED ON HRTEM IMAGE PROCESSING ANALYSIS

Tonejc A. Farrants GW. Hovmoller S. - Croatica Chemica Acta. 72(2-3):311-326, 1999

We investigated, using high resolution electron microscopy and image processing, the early stages of the mechanical. alloying process of a mixture of zirconia and yttrium oxide powders. Molar fraction of yttrium oxide was 0.10. We focused our investigation on the grain boundary region and the region of overlapping layers of zirconia and yttria. Fourier filtering revealed, at the atomic level, one possible sequence of alloying, which occurred in the grain boundary and in the overlapping layers.

[14] NANOSTRUCTURAL CHARACTERISTICS AND SINTERING BEHAVIOR OF W-CU COMPOSITE POWDER PREPARED BY MECHANICAL ALLOYING

Kim JC. Ryu SS. Moon IH. - Journal of Advanced Materials. 31(4):37-44, 1999

W-Cu alloy is one of the promising materials for heat sinks and packaging in the microelectronic devices due to its good thermal properties. In the present study, nanostructured (NS) W-Cu composite powder was prepared by the mechanical alloying (MA), and their nanostructural evolutions with milling times were analyzed by SEM, XRD and TEM. MA W-Cu powder milled for 50 hours was characterized by equiaxed shape with mean particle size of 2-3 mu m, and crystalline size was about 20-30nm. The MA NS W-20wt%Cu and W-30wt%Cu powders compacts had shown the high sinterability, resulting in a nearly full density by sintering at 1100 degrees C. The enhanced sinterability of MA W-Cu composite powder was attributed to the nanostructural characteristics of W and Cu phases as well as the activated sintering of Fe-impurity.

[13] PHASE COMPOSITION AND STRUCTURE OF FE-MN ALLOYS PREPARED BY MECHANICAL ALLOYING FROM ELEMENTAL POWDERS

Tcherdyntsev VV. Kaloshkin SD. Tomilin IA. Shelekhov EV. Baldokhin YV. - Zeitschrift fur Metallkunde. 90(9):747-752, 1999

Fe-Mn alloys were prepared in a wide concentration range of the components by mechanical alloying (MA) of elemental Fe and Mn powders in a high-energy planetary ball mill. The phases occurring in the mechanically alloyed (MA) samples are similar to those existing according to the equilibrium phase diagram, but the concentration ranges of existence of single-phase solid solutions were extended markedly. In alloys with fee structure high concentrations of stacking faults were observed. The kinetics of structure transformations at the MA processing was investigated for

the Fe50Mn50 alloy.

[12] STRUCTURAL PROPERTIES AND PROTON CONDUCTIVITY OF THE 12-TUNGSTOPHOSPHORIC ACID DOPED ALUMINOSILICATE GELS

Mioc UB. Milonjic SK. Stamenkovic V. Radojevic M. Colomban P. Mitrovic MM. Dimitrijevic R. - Solid State Ionics. 125(1-4):417-424, 1999

Preparation of aluminosilicate gels bulk, containing 12-tungstophosphoric acid (WPA) in mesopores, as well as their structural and conduction characteristics are reported. Doped gels are prepared from aluminum-silicon alkoxide AlSi(OR)(x), iso-propanol, water and WPA . 29H(2)O mixtures. Characteristics of the obtained doped gels depend on the WPA content. Results such as WPA-filled mesopores and infra red (IR) band shifts indicate differences with respect to material obtained by mechanical alloying and interaction between the WPA and aluminosilicate host framework. According to the obtained results, especially of the higher conductivity (sigma similar to 10(-3) S/cm), WPA-doped aluminosilicate gel is a promising material for solid electrolytes.

[11] KINETICS OF FORMATION OF THE GAMMA-NI20ZN80 ALLOY USING NANOCRYSTALLINE NICKEL

Grandi TA. dos Santos VHF. de Lima JC. - Solid State Communications. 112(7):359-364, 1999.

In this work we investigated the kinetics of formation of gamma-Ni20Zn80 alloy using nanocrystalline nickel obtained via mechanical milling. The alloy was prepared by a thermo-mechanical process developed in our laboratory. Through a systematic study, considering the variation of alloying temperature and the crystallite size, we have quantified the relationships between the reaction rate and these parameters.

[10] EFFECT OF NANOPOWDER DEAGGLOMERATION ON THE DENSITIES OF NANOCRYSTALLINE CERAMIC GREEN BODIES AND THEIR SINTERING BEHAVIOUR

Ferkel H. Hellmig RJ. - Nanostructured Materials. 11(5):617-622, 1999

The agglomeration of nanoscaled powders in general decreases the density of green bodies pressed from those nanopowders. Depending on the strength and morphology of the agglomerates different densities can be achieved. It is shown that in the case of ceramic nanopowders as alumina and yttria-stabilised zirconia which are produced by laser ablation technique or in the case of alumina also by physical vapour synthesis process the stronger agglomerates can easily be cracked by a short milling procedure. Green bodies pressed from the conditioned nanopowders exhibit up to 15% larger densities than bodies made from unmodified nanopowders. Due to the decreased porosity in those specimens the sintering activity is significantly increased and therefore ceramics of up to 99% of the theoretical density having median grain diameters less than 500 nm can be manufactured under simplified processing conditions.

[9] NMR INVESTIGATION OF MECHANICALLY MILLED NANOSTRUCTURED GAF3 POWDERS

Bureau B. Guerault H. Silly G. Buzare JY. Greneche JM. - Journal of Physics-Condensed Matter. 11(40):L423-L431, 1999

High-energy ball milling is suitable for the preparation of nanostructured powders. First, high-resolution, solid-state nuclear magnetic resonance (NMR) investigations of F-19, Ga-69 and Ga-71 in ball-milled ionic GaF3 are presented. The quadrupolar parameter and the isotropic chemical shift distributions are determined for the three nuclei. The quadrupolar parameter distributions give clear evidence of two main structurally different phases in mechanically milled GaF3. A discussion based upon molecular dynamics simulations allows us to distinguish these two phases according to the size of the distortion of the GaF6 octahedral units: the lowest distortion is related to crystalline grains and the highest one to grain boundaries. It is thus concluded that NMR is a technique well adapted to the quantification and characterization of these two phases.

[8– KINETICS OF FORMATION OF NANOCRYSTALLINE PHASES BY MECHANOCHEMICAL REACTION BETWEEN TI AND RUO2

Blouin M. Guay D. Schulz R. - Journal of Materials Science. 34(22):5581-5588, 1999

The structural evolution of a mixture of Ti and RuO2 mechanically alloyed over a period of 40 h was followed with respect to time by X-Ray diffraction. The structural parameters were extracted from the XRD traces by performing a Rietveld refinement analysis. The phase formation occurs in three distinct stages. In stage I (first 10 min of milling), RuO2 and Ti reacts to form RuTi, Ru, and TiO, with some other oxide phases of titanium (Ti2O3, and TiO2). In stage II (between 10 and 60 min), the reaction slows down and the titanium dioxides are being reduced. In stage III, decomposition of RuTi through reaction with Ti2O3 occurs, to yield to the formation of TiO and Ru. In stage I, the reaction rate is very high, for example, 34.7 wt % of RuTi is formed after only 10 min of milling. It is argued that such rapid reaction rate is due to the enthalpy of the redox reaction occurring between Ti and RuO2 which raised the local temperature and thus favors the atomic interdiffusion. Finally, a series of experiments performed as a function of the milling intensity points to the existence of an energy threshold below which the combustion reaction between Ti and RuO2 does not occur.

[7] TIME EVOLUTION OF THE STRUCTURAL SHORT-RANGE ORDER DURING THE MECHANICAL MILLING OF FE-CO-CU NANOCRYSTALLINE ALLOYS

Gay-Sanz N. Prieto C. Munoz-Martin A. de Andres A. Vazquez M. Yu SC. - Journal of Materials Research. 14(10):3882-3888, 1999

The local order around Fe, Co, and Cu atoms was investigated by extended x-ray absorption fine structure spectroscopy in Fe-Co-Cu nanocrystalline alloys prepared by mechanical alloying, In order to study the time evolution of the alloying process, Fe30Co20Cu50 samples were studied after several processing times. The analysis of the data shows that, in a first step, a binary Co-Cu alloy is formed, but iron remains separate in the form of nanocrystals with a high defect concentration. Afterwards, in a second step, the final ternary Fe-Co-Cu alloy with the face-centered-cubic structure is obtained.

[6] REDUCTION OF COPPER OXIDE WITH GRAPHITE BY MECHANICAL ALLOYING

Liu L. Zhang TJ. Cui K. Dong YD. - Journal of Materials Research. 14(10):4062-4069, 199

The reduction of CuO with different amounts of C (CuO:C = 2:1, 2:1.5, and 2:2 molar ratios) driven by mechanical alloying was examined by x-ray diffraction and transmission electron microscopy. It was found that reduction behaviors are closely related to the carbon content. The reduction of CuO for the mixture with 1 mol of carbon follows

a two-step process; i.e.. CuO --> Cu --> Cu2O. However, the CuO can be completely converted to Cu for the mixtures with higher carbon content. A tentative model in terms of solid-state reactions at the interfaces is proposed to explain the effect of carbon content. Additionally, the thermal responses of the premilled mixtures were investigated by thermogravity and differential thermal analysis followed by x-ray identification. Contrary to mechanical alloying, reduction of CuO during thermal treatment follows a transition sequence of CuO -- Cu2O --> Cu. The preferential formation of Cu2O at the early annealing stage is probably due to the involvement of gaseous reduction.

[5] MODIFIED HDDR PROCEDURES APPLIED TO NDFEB ALLOYS

Gutfleisch O. Gebel B. Kubis M. Muller KH. Schultz L. - IEEE Transactions on Magnetics. 35(5 Part 2):3250-3252, 1999

The magnetic properties of Nd16.2Fe78.2B5.6, Nd12.6Fe81.4B6.0, and Nd12.6Fe69.4Co11.0Ga1.0B6.0 alloys after the application of modified HDDR (hydrogenation-disproportionation-desorption-recombination procedures have been investigated and particular emphasis has been given to the development of magnetic anisotropy and high coercivity in these different types of materials. Conventional HDDR processing leads to anisotropic material only in the case of the Nd12.6Fe69.4Co11.0Ga1.0B6.0 alloy. Combining solid-disproportionation with a controlled recombination under partial hydrogen pressure at 900 degrees C, a significant degree of anisotropy and a good coercivity were achieved for the two ternary alloys. These findings indicate the possibility of more than one mechanism and the relevance of the rod-like solid-disproportionated structure for the inducement of anisotropy. Another modification of the standard procedure, the reactive milling technique, leads to isotropic Nd16.2Fe78.2B5.6 powder with grain sizes, both in the disproportionated and recombined states, significantly smaller than those of conventional powder and a very high coercivity of mu(0J)H(c)=1.88T.

[4] EFFECT OF FEGA3 POWDER ADDITION ON THE MAGNETIC PROPERTIES OF NDFEB SINTERED MAGNETS

Zhao TS. Kim YB. Jeung WY. - IEEE Transactions on Magnetics. 35(5 Part 2):3301-3303, 1999

NdFeB sintered magnets with the addition of various amounts of FeGa3 powder were prepared by blending during the ball milling process, The magnetic properties and microstructure of the NdFeB magnets were studied. It was found that the addition of 0.1-0.2 wt.% FeGa3 powder increases the coercivity of the magnets without reducing the remanence. The improvement in coercivity by the addition of FeGa3 powder may be related to the formation of a Nd6Fe14-xGax (x congruent to 1) intergranular phase in the magnets.

[3] THE SIZE ESTIMATION OF THE BI-YIG NANO-PARTICLES DISPERSED IN A PLASTIC BINDER

Hirano T. Namikawa T. - IEEE Transactions on Magnetics. 35(5 Part 2):3487-3489, 1999

Nano-size Bi1.8Y1.2Fe5O12 particles were prepared with a coprecipitation and heat-treatment method. The coating films of the particles were prepared with coating techniques. The crystalline sizes of the Bi1.8Y1.2Fe5O12 particles were calculated. using the Scherrer equation with the X-ray diffraction data. The calculated size of the 0 h milling particle is about 400 nm that is almost the same as the measured size with a transmission electron microscope. The calculated particle size of 100 h milling Is about 50 nm that is almost the same as the measured size with an atomic force microscope. The size of the prepared Bi1.8Y1.2Fe5O12 particles is changed with the milling process. The crystalline size calculation using the Scherrer equation with the X-ray diffraction data is a method of a size estimation of nano-size Bi1.8Y1.2Fe5O12 fine particles.

[2] MAGNETIC PROPERTIES OF NANO-CRYSTALLINE FE-CR ALLOYS PREPARED BY MECHANICAL ALLOYING

Murugesan M. Kuwano H. - IEEE Transactions on Magnetics. 35(5 Part 2):3499-3501, 1999

Fe-Cr powdered alloys synthesized via mechanical attrition have been examined by magnetization and Fe-57 Mossbauer spectroscopy. Mossbauer studies reveal that Fe1-xCrx becomes paramagnetic for x greater than or equal to 0.46 after 100 h milling. Magnetization results suggest that a significant reduction of Fe magnetic moment occurs in the nano-crystalline Fe1-xCrx alloys. Curie temperature for x = 0.46 and 0.69 lies below liquid N-2 and liquid He temperature, respectively.

[1] FORCED REACTIONS IN INORGANIC AND ORGANIC CHEMISTRY

Butyagin PY. - Colloid Journal. 61(5):537-544, 1999

The main fields of study carried out at the Russian Academy of Sciences that have resulted in the foundation of mechanochemistry as an independent branch of chemical science are briefly reviewed. Over a few decades, the hypotheses that thermal excitement of chemical reactions is induced by the impact or friction have been replaced by rigorous physical notions on the mechanisms and the elementary stages of processes induced by stresses and deformation in solids. Among these notions are the theory of the separation of an electrical double layer during the fracture of solids; the demonstration of mechanical rupture of chemical bonds and the description of the subsequent reactions of free radicals; the creation of the kinetic theory of strength; the elucidation of the phenomenon of deformational mobility of atoms and molecules, which is sufficient for the occurrence of chemical reactions in the solid phase "in a cold state;" and the doctrine of the nature of mechanical activation as the most important tool affecting the reactivity of solids. To implement activation of forced chemical reactions, the theory was developed and high-power reactors were designed.

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