

# RESEAU FRANÇAIS DE MECANOSYNTHESE

## Lettre N° 54

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**Septembre 1999**

**155 Groupes de Recherche**  
(dont 83 à l'étranger / 34 Pays)

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

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**Le site web du RFM est le suivant**  
**<http://www.bls.fr/amatech>**

Rubrique Pages Sciences et Techniques pour l'Ingénieur (Rubrique Sciences)  
vous y trouverez les anciennes lettres du RFM (accessible par Adobe Acrobat)  
les statuts du RFM ainsi que les annonces concernant les JRFM'99 et quelques éléments mis à jour régulièrement  
concernant les derniers résultats dans ce domaine.

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

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#### **EUROSOLID**

6 - 10 Septembre 1999 - Carry le Rouet - France

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#### **SMM14**

14th International Conf. on Soft Magnetic Materials  
8 - 10 Septembre 1999 Balatonfüred - Hongrie  
web site : <http://www.kfki.hu> - Subsite : smm14

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#### **EUROMAT 99**

20 - 30 Septembre 1999 - Munich- Allemagne  
E-Mail : [euromat@dgm.de](mailto:euromat@dgm.de)  
Web Site : <http://www.euromat.fems.org>

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#### **Elaboration et Transformation des Solides Divisés** (Ecole Thématique)

21 - 24 Septembre 1999 Carry le Rouet - France  
Renseignements : F. Gruy - ENSM St Etienne  
E-Mail : [gruyemse.fr](mailto:gruyemse.fr)

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#### **Int. Symp. Cluster and Nanostructure Interfaces (ISCANI)**

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

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#### **Processing and Properties of Structural Nanomaterials** **TMS Fall Meeting**

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

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#### **J.A. 99 / SF2M**

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

Adresse : SF2M - 1 Rue de Craiova - 92024 Nanterre Cedex

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**EURO PM99**

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

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**MRS Fall Meeting 99**

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

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**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](mailto:gsu@iitk.ac.in)

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**Ultrafine Grained Materials**

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

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**JRFM'2000**

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

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**4th EUROMECH**

26 - 30 Juin 2000 - Metz - France  
E-Mail : [euromech@lpmm.univ-metz.fr](mailto:euromech@lpmm.univ-metz.fr)  
WebSite : <http://www.lpmm.univ-metz.fr/euromech>

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**III European Conference on Fluidization**

29 - 31 Mai 2000 - Toulouse - France  
E-Mail : [Progep@ensigct.fr](mailto:Progep@ensigct.fr)

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**XIVth International Symposium on the Reactivity of Solids**

**Budapest, Hungary through 27-31 August 2000**

<http://www.jate.u-szeged.hu/~isrs14>

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**Solid State Chemistry 2000**

**Prague, Czech Republic, September 3 - 8,2000**

(Information provided by Klara Tkacova)

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

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

**International Conference on Mechanochemistry and Mechanical Alloying INCOME.**

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

and

**3rd INCOME**

**International Conference on Mechanochemistry and Mechanical Alloying**

**Prague, Czech Republic, September 4 - 8,2000**

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

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

## **XIVth International Symposium on the Reactivity of Solids**

**Budapest, Hungary through 27-31 August 2000**

<http://www.jate.u-szeged.hu/~isrs14>.

Some glimpses at the history and the role of the International Symposium on the Reactivity of Solids. Since 1948 distinct scientists from all over the world have been gathering at the International Symposium on the Reactivity of Solids to elucidate and discuss the recent results and experimental developments on wide-spread endeavours in the fields of the reactivity of solids. A characteristic feature of this symposium is that its organization lays in the hands of local organizing committee. There is no mighty society in the background, it lives on the enthusiasm and on the scientific curiosity of a world-wide community working on this important topic. Some landmarks highlighted by these efforts were:

- 1948 Paris France
- 1952 G<sup>te</sup>teborg Sweden
- 1956 Madrid Spain
- 1960 Amsterdam The Netherlands
- 1964 Munich Germany
- 1968 Schenectady USA
- 1972 Bristol United Kingdom
- 1976 G<sup>te</sup>teborg Sweden
- 1980 Cracow Poland
- 1984 Dijon France
- 1988 Princeton USA
- 1992 Madrid Spain
- 1996 Hamburg Germany

The XIVth International Symposium on the Reactivity of Solids will be held in Budapest, Hungary through 27-31 August 2000. The scope of the symposium involves areas ranging from basic research to applied- and material sciences, from aspects of technology, economy and ecology. The subjects discussed cover topics of various materials, chemical processes and different concepts on elucidating the mechanism of reactions in the solid phase. The aim of the symposium is to provide an opportunity to extend current knowledge, promote progress, and open up new vistas in the field. We are highly motivated to organize a successful but nevertheless hearty symposium.

### **ORGANIZATION**

The XIVth International Symposium on the Reactivity of Solids is organized under the auspices of the following committees:

#### **CHAIRMAN**

F. Solymosi - University of Szeged

#### **INTERNATIONAL ADVISORY BOARD**

M. A. Alario-Franco (Spain), M. A. Blesa (Argentina), E. Boldyreva (Russia), C. B. Carter (USA), C. R. A. Catlow (United Kingdom), P. K. Davies (USA), G. R. Desiraju (India), L. C. Dufour (France), P. P. Edwards (United Kingdom), P. Grange (Belgium), J. R. G<sup>nter</sup> (Switzerland), J. Haber (Poland), D. Jiang (P. R. China), M. Lahav (Israel), M. Martin (Germany), I. V. Murin (Russia), R. Naslain (France), A. Negro (Italy), T. Norby (Norway), C. N. R. Rao (India), A. Reller (Germany), M. Senna (Japan), S. Shimada (Japan), F. Solymosi (Hungary), Y. D. Tretyakov (Russia), H. Verweij (The Netherlands), M. Yoshimura (Japan), M. S. Whittingham (USA).

#### **SCIENTIFIC COMMITTEE**

V. V. Boldyrev, M. Che, T. Nishino, H. Schmalzried, F. Solymosi, F. S. Stone, J. M. Thomas,

#### **LOCAL ORGANIZING COMMITTEE**

P. Barna, L. Bartha, I. Bert<sup>Úti</sup>, J. G<sup>lber</sup>, L. Gucci, G. Kliv<sup>Ènyi</sup>, L. Kotsis, Gy. Pokol, J. Rask<sup>Ú</sup>, F. Solymosi.

#### **SCOPE OF THE SYMPOSIUM**

This Symposium covers a range of topics related to the design of solids exhibiting specific physical and chemical properties, to the characterization of transport and critical phenomena in solids as well as to the investigation of the thermochemical reactivity of solids.

### SCIENTIFIC CORRESPONDENCE

Chairman  
Prof. F. Solymosi  
Institute of Solid State  
and Radiochemistry  
University of Szeged  
H-6701 Szeged, P.O.Box  
168, Hungary

Phone: +(36) 62 420 678  
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Hungary

Phone: +(36) 62 424 997  
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Sciences  
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Phone: +(36) 1 325 8147  
Fax: +(36) 1 325 7892

E-mail:  
Bertoti@chemres.hu

Those planning to submit an abstract and/or attend the XIVth ISRS are requested to complete the attached preliminary registration form and to return it not later than 30 September 1999.

### SCIENTIFIC PROGRAM

The scientific program is based on plenary lectures, invited lectures, oral communications and poster presentations highlighting the following topics:

- \* Novel synthesis pathways to tailor-made materials
- \* Catalysts preparation and new catalytic materials
- \* Formation and reactivity of nanoscale and mesoscale systems
- \* Defects and transport phenomena in solids
- \* Thermal decomposition
- \* Processes at interfaces and surfaces
- \* Formation and reactivity of organic and polymer materials
- \* Ceramic materials: Impact on processing and properties
- \* Solid state chemistry of fullerenes
- \* Materials exhibiting novel specific properties
- \* Environmental issues of reactivity of solids
- \* Superconducting materials and related solids

Distinguished scientists will present plenary lectures and invited talks. Their names will be given in the second circular. The official language of the Symposium will be English

### CALL FOR ABSTRACTS

Participants are invited to submit papers on any aspect of the general topic Reactivity of Solids. In order to allow the participants to present their latest research results the deadline for submission of abstracts has been scheduled on 31 January 2000.

Authors will receive e-mail notification of acceptance and type of presentation (oral or poster) until the end of March 2000. Accepted abstracts will appear in the Preliminary Programme which will be issued to all participants who have registered. It will also be available via the website at:

<http://www.jate.u-szeged.hu/~isrs14>.

### 3rd INCOME

#### International Conference on Mechanochemistry and Mechanical Alloying

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

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

The Conference INCOME 2000 will take place in conjunction with the conference Solid State [advisory board] Advisory Chemistry 2000 organized by the Institute of Board Inorganic Chemistry, Academy of Sciences the Czech Republic, under the auspices of the International Mechanochemical Association and of the Slovak Chemical Society.

It continues the tradition established by INCOME in 1993 in Slovakia and 1997 in Russia. The conference will provide comprehensive overview of fundamentals, technology and application in this rapidly progressing field of solid state chemistry and materials science.

#### Key Topics:

1. fundamentals and models of mechanically stimulated processes
2. mechanically induced changes in structure and properties
3. mechanochemical reactions and enhancing of self-sustaining reactions by mechanical activation
4. methods and equipments for preparing and characterization of active powders

#### Conference committees chairperson:

Prof. Klára Tkáčová, Slovak Republic

#### International advisory board:

Igor Boldyrev Russia  
Andrzej Calka Australia  
Giorgio Cocco Italy  
José M. Criado Spain  
Eric Gaffet France  
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Eugene Ivanov USA  
Carl C. Koch USA  
Ludwig Schultz Germany  
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Nadezda Stevulova Slovak Republic  
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Lajos K. Varga Hungary  
Evgeny Yermakov Russia

#### Organising Committee:

Petr Bezdička IIC  
Markéta Bláhová Czech Chemical Soc.  
Jana Bludská IIC  
Tomáš Grygar IIC  
Ivo Jakubec IIC  
Miloslav Karel IIC  
Ivo Paseka IIC  
Jiří Vondrák IIC

**International Workshop on  
APPLIED ASPECTS OF INTERFACE SCIENCE (AAIS)  
(St.Petersburg, Russia; September 22 - 24, 1999)**

**Announcement:**

If any one technology can be said to shape the face of today society, it is materials technology. New materials, materials processes and applications are of major importance in boosting other military and civilian technological sectors such as electronics, energy technology and aerospace engineering. The objective of this Workshop is to present current research on advanced nanostructured materials and high temperature superconducting materials (characterized by nano-scaled coherence length) with the special attention being paid to the effect of interfaces on the unique, commonly highly desired properties of such materials as well their applications in various high technology areas. The Workshop aims to assess the current status and to identify future directions of R&D and applications of nanostructured bulk solids, films and coatings as well as polycrystalline superconducting materials. Particular emphasis is placed on developing close interactions and fostering future collaborations among scientists and engineers from the USA, Russia and other countries. We plan to focus to the following topics: Synthesis and processing; Modeling; Characterization and properties (mechanical and transport properties of nanostructured materials, high- and low-current properties of superconducting materials); Applications.

**International Organizing Committee:**

R.Masumura (Naval Research Laboratory, USA) I.Ovid'ko (Russian Academy of Sciences, Russia)  
C.Pande (Naval Research Laboratory, USA) B.Smirnov (Russian Academy of Sciences, Russia)  
M.Soto (Office of the US Naval Research, USA)

**Local Organizing Committee:**

Chairman: I.Ovid'ko (RAS)

Members: D.Grigorieva (RAS), T.Orlova (RAS), A.Reizis (RAS), B.Smirnov (RAS)

**Contacts:**

Dr.Ilya Ovid'ko - Institute of Problems of Mechanical Engineering, Russian Academy of Sciences  
Bolshoj 61, Vas.Ostrov, St.Petersburg 199178, Russia Phone: +(7 812)321 4764  
Fax: +(7 812)321 4771 - E-mail: ovidko@def.ipme.ru

**List of AAIS invited speakers:**

Prof.E.L.Aero (Institute of Problems of Mechanical Engineering, Russia)  
Prof.R.A.Andrievskii (Institute of Chemical Problems, Russia)  
Dr.U.Balachandran (Argonne National Laboratory, USA)  
Prof.N.Browning (University of Illinois at Chicago, USA)  
Prof.G.-M.Chow (National University of Singapore, Singapore)  
Dr.J.Eastman (Argonne National Laboratory, USA)  
Dr.E. Gaffet (CNRS / UTBM - Nanomaterials Research Group, France)  
Dr.K.Goretta (Argonne National Laboratory, USA)  
Prof.Y.Gogotsi (University of Illinois at Chicago, USA)  
Dr.P.Hazzledine (Universal Energy System, USA)  
Dr.P. Jena (Virginia Commonwealth University, USA)  
Prof.G.Kiriakidis (IESL/FORTH, Greece)  
Prof.P.Klimanek (Freiburg Technical University, Germany)  
Prof.J.-Y.Laval (CNRS/ESPCI, France)  
Prof.S.Majetich (Carnegie-Mellon University, USA)  
Dr.R.A.Masumura (Naval Research Laboratory, USA)  
Dr.K.Merkle (Argonne National Laboratory, USA)  
Dr.T.Orlova (Ioffe Physico-Technical Institute, Russia):  
Dr. I.Ovid'ko (Institute of Problems of Mechanical Engineering, Russia)  
Dr. C.Pande (Naval Research Laboratory, USA)  
Dr.B.B.Rath (Naval Research Laboratory, USA)  
Prof.B.Smirnov (Ioffe Physico-Technical Institute, Russia)  
Dr.M.Soto (Office of Naval Research, USA)  
Prof.R.Valiev (Institute of Advanced Materials, Russia)  
Prof.O.G.Vendik (State Electrotechnical University, Russia)

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**SOUTENANCE DE THESE**  
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**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**

Since 1972, hydriding alloys have been studied as materials for Ni - MH batteries. The first generation of alloys, already commercialized, is based on AB<sub>5</sub> compounds. They form hydrides with the following formula : AB<sub>5</sub>H<sub>6</sub>. Their maximum electrochemical capacity measured was around 330 mAh/g. A second generation is based on AB<sub>2</sub> compounds. Their hydride formula is AB<sub>2</sub>H<sub>3</sub>. Their maximum electrochemical capacity measured was around 400 mAh/g. The aim of the following work is to synthesize and study alloys which exhibit better properties than the alloys AB<sub>5</sub> on the market.

The results obtained during this work showed the practical interest of milling and mechanical alloying regarding hydrides. First, it was possible to improve the hydrogen absorption properties of an AB<sub>2</sub> alloys, by milling it with Mg<sub>2</sub>Ni or Nickel. This treatment enhanced the following absorption properties :

Surface activation,

Hydrogen absorption kinetics,  
first cycles discharge capacities.

Furthermore, mechanical alloying, followed by annealing, allowed us to substitute partially zirconium with magnesium in an AB<sub>2</sub> alloy. The elaboration of alloys containing zirconium and a substantial amount of magnesium was a première. The alloy Zr<sub>0.5</sub>Mg<sub>0.5</sub>(Mn<sub>0.6</sub>Ni<sub>0.6</sub>V<sub>0.6</sub>Cr<sub>0.1</sub>) was synthesized and showed interesting characteristics regarding hydrogen absorption. Unfortunately, resistance to electrochemical cycling was bad. Using the same synthesis process, the nanocrystalline alloy Zr<sub>0.65</sub>Ti<sub>0.35</sub>Cr<sub>2</sub> was made. It was shown that this compound had an excellent solid - gas capacity, equivalent to 460 mAh/g.

In a second part, the alloys of the Mg - Ni system were studied. Optimizing milling time and intensity, the compound Mg<sub>2</sub>Ni was elaborated after 4 hours of milling at intensity 10. This nanocrystalline alloy exhibited a discharge capacity of 210 mAh/g whereas polycrystalline Mg<sub>2</sub>Ni only discharged 8 mAh/g. This enhancement was attributed to the presence of a disordered phase. We also attempted to synthesize the Mg<sub>50</sub>Ni<sub>50</sub>. Unfortunately, we could not obtain such an alloy. Indeed, despite changing the milling parameters, a phase containing Mg<sub>2</sub>Ni or MgNi<sub>2</sub> was always observed. It seems that the formation of stable phases instead of the metastable phase was due to excess energy brought by the milling.

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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**

**\*\*\* Looking for Job Position**

(6th July 1999)

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

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

**\*\*\*\* Proposals**

**FRANCE (2/07/99)**

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

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

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

**FRANCE (6/06/99)**

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

Contact : pbrac@u-bourgogne.fr

**GRECE (11/06/99)**

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

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

**ISRAËL (14/5/99)**

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

**Denmark (22/02/99)**

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

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

**Québec (CANADA) ( 22/01/99)**

Institut National de la Recherche Scientifique

DÉpartement ...nergie et Matériaux

**POST-DOCTORAL POSITION IN Ni-MH BATTERY TECHNOLOGY**

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

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

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

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

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

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

Pr. Lionel ROUE

INRS- Energie et Matériaux

1650, bd. Lionel Boulet

Varenes, Québec, CANADA

J3X 1S2

E-Mail: [HYPERLINK mailto:roue@inrs-ener.quebec.ca](mailto:roue@inrs-ener.quebec.ca) / [roue@inrs-ener.quebec.ca](mailto:roue@inrs-ener.quebec.ca)

**USA (17/12/98)**

Rutgers University is seeking a postdoctoral associate with demonstrated expertise in mechanochemistry to work on research focused on biomaterials. The candidate must be able to work on research focused on biomaterials. The candidate must be able to work as part of multidisciplinary team involving industry and academia focused on making biomedical implant devices. The candidate should demonstrate the ability to work independently, publish in archival journals and present their work in a public forum. The candidate should send a curriculum vitae, three representative publications (preferably with the candidate as a first author) and the names, address, email and phone numbers of three references that can comment on the candidate's capabilities. The position is available immediately at a salary of \$32,000 with health benefits included. The position will be posted until a suitable candidate is identified. Interested candidates should send correspondence to

Professor R.E. Riman

Rutgers University Department of Ceramic and Materials Engineering

607 Taylor Road Piscataway, NJ 08854 - 8065

[Riman@alumina.rutgers.edu](mailto:Riman@alumina.rutgers.edu)

## Bibliographie Récente

### Livres ou "Special Issues"

#### "Non Equilibrium Processing of Materials"

R.W. Cahn - Elsevier Science - Volume 2 in the Pergamon Materials Series

A large number of technical papers have been published in reviews, monographs and conference proceedings, but have almost always been devoted to a single processing technique. This book, however, covers all the non equilibrium processing methods and their effects in a single volume.

web site : [www.elsevier.nl/locate/isbn/0080426972](http://www.elsevier.nl/locate/isbn/0080426972)

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#### Bulk Amorphous Alloys : Preparation and Fundamental Characteristics

A. Inoue

Materials Science Foundation Vol. 4 - Trans Tech Publications : <http://www.ttp.net>

Interest in bulk amorphous alloys has increased rapidly throughout the world and these materials have now gained a position of great importance in basic science and engineering materials technology. Bulk amorphous alloys based upon the Zr - Al - Ni - Cu, Zr (Ti,Nb) - Al - Ni - Cu and Zr - Ti - Ni - Cu - Be systems have already achieved wide commercial success as components of various technical accessories ranging from sporting goods to optical instruments.

Here is a state of the art reviews on this new group of materials, covering all areas of interest, ranging from the synthesis of these special alloys and their fundamental properties, to their engineering characteristics and applications.

This work will therefore be of equal interest to those who wish to become fully acquainted with the subject, and to those who are already actively engaged in the field.

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#### 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-Al<sub>4</sub>C<sub>3</sub> 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

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#### "Mechanical Alloying"

Auteurs : Li Lü & Man On Lai(National University of Singapore)

Kluwer Academic Publishers

**Contents** : Preface - Introduction to Mechanical Alloying - Experimental Set - Up - The Mechanical Alloying Process - Formation of New Materials - Characterization of Powders - Densification - Mechanical Properties - Mechanisms of Mechanical Alloying - Modeling of Mechanical Alloying - Index

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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 nanométrie) ; les conférences et les forums sur Internet se multiplient où s'échangent des informations sur les avancées scientifiques et technologiques dans ce domaine des matériaux nanostructurés qui se distinguent des matériaux polycristallins conventionnels par la dimension des cristallites les composant ou par la dimension des hétérostructures présentes : ces dimensions sont de quelques dizaines d'angströms, voire de quelques nanomètres. A ces dimensions, les propriétés des matériaux changent radicalement.

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

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

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

### CHEMISTRY FOR SUSTAINABLE DEVELOPMENT

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

Proceedings of 2d International Conference on Mechanochemistry

(INCOME-2), which was held in Novosibirsk in 1997.

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

### Mechanochemistry of Materials Cambridge International Science Publishing

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

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

### BIBLIOGRAPHY ON MECHANICAL ALLOYING AND MILLING

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

The present bibliography covers information on mechanical alloying and milling of materials starting from 1970 (when it was recognized that MA has become a commercial/viable material processing technique instead of just a grinding method) to 1996. All the available references will be presented in a chronological fashion. Under each year, (.....)

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

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

## PERIODIQUES

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

### [37] SOLID-STATE MECHANOCHEMICAL MODIFICATION OF POLYOLEFINS [RUSSIAN]

Zelenetskii AN. Sizova MD. Volkov VP. Artem'eva NY. Egorova NA. Nikol'skaya VP. - *Vysokomolekulyarnye Soedineniya Seriya A & Seriya B.* 41(5):798-804, 1999

Study of the mechanochemical modification of PE and PP with maleic anhydride, maleic acid, and sodium maleate in the melt and in the solid state showed inversion of the reactivity of comonomers in the case of processes performed in the different phase: states, Variation of the granulometric composition of Mt in the solid state revealed correlation between the degree of comonomer grafting and the amount of plastic deformation of the polymer particles. The initial and modified Pr samples were analyzed in a derivatograph. On the basis of the thermoanalytical data, a mechanism of the thermooxidative degradation of the polymer is suggested. The combination of experimental data obtained suggests that the main controlling factor in the solid-state modification of polyolefins is the joint plastic deformation of the system components.

### [36] DEHYDRATION BEHAVIOUR OF A NATURAL GYPSUM AND A PHOSPHOGYPSUM DURING MILLING

Strydom CA. Potgieter JH. - *Thermochimica Acta.* 332(1):89-96, 1999

The paper describes an investigation into the dehydration behaviour of a natural and a phosphogypsum under isothermal conditions. The purpose of the work was to assess whether there is a difference in the dehydration behaviour and what effects it could possibly have in practical applications in the cement industry. It was found that there is a significant difference in the amounts of moisture loss from the two materials under the same temperature conditions as well as their respective surface areas after dehydration. The results of the investigation indicate that great care should be exercised under production conditions when changing from the use of a natural gypsum as set retarder for cement to using a phosphogypsum.

### [35] CU<sub>40</sub>Mg<sub>60</sub> AND CU-MGO POWDERS PREPARED BY BALL-MILLING: CHARACTERIZATION AND CATALYTIC TESTS

Mulas G. Varga M. Bertoti I. Molnar A. Cocco G. Szepvolgyi J. - *Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing.* 267(2):193-199, 1999

Cu<sub>40</sub>Mg<sub>60</sub> amorphous alloy powders, prepared by mechanical alloying of the constituent elements, and Cu-MgO samples, made by the self-sustaining reaction between Cu<sub>2</sub>O and Mg in stoichiometric amounts and additional ball milling, were characterized by physical methods (DSC, XRD, and XPS). The catalytic properties of the specimens were tested in the dehydrogenation of 2-propanol and in the one-step synthesis of methyl isobutyl ketone from acetone. The samples exhibited high activities and selectivities in the dehydrogenation of 2-propanol. In contrast, their overall performance in the synthesis of methyl isobutyl ketone is inferior to that of Cu-on-MgO prepared by conventional methods. The catalytic performances of the samples are interpreted by the structural and surface changes induced by the catalytic reactions.

### [34] THE MECHANOCHEMICAL CONVERSION OF ACETONE TO METHYL ISOBUTYL KETONE OVER CU-MG BASED SUBSTRATES

Mulas G. Deledda S. Cocco G. - *Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing.* 267(2):214-219, 1999

Selected results concerning the acetone conversion to methyl isobutyl ketone promoted by mechanical energy are presented. Cu-MgO composites at different Cu contents and amorphous Cu<sub>40</sub>Mg<sub>60</sub>, prepared by different ball milling techniques, were employed as solid substrates for the mechanochemical process. The conversion and selectivity values of the acetone transformation were followed under Ar and H<sub>2</sub> reaction atmosphere and as a function of the impact energy. The mechanical treatment under H<sub>2</sub> resulted mainly in acetone hydrogenation leading to 2-propanol, while under Ar, the formation of diacetone alcohol, mesityl oxide and methyl isobutyl ketone (MIBK) was observed. Conversion changes and selectivity shifts were observed depending on the substrates employed, and the largest amount of MIBK; was obtained when amorphous Cu<sub>40</sub>Mg<sub>60</sub> was used. An important structural transformation occurred during the mechanochemical runs.

### [33] RECENT DEVELOPMENTS IN THE APPLICATIONS OF NANOCRYSTALLINE MATERIALS TO HYDROGEN TECHNOLOGIES

Schulz R. Huot J. Liang G. Boily S. Lalande G. Denis MC. Dodelet JP. - *Materials Science & Engineering A-Structural Materials Properties Microstructure & Processing.* 267(2):240-245, 1999

The paper discusses the application of nanocrystalline alloys as hydrogen storage materials and as electrocatalysts for solid polymer electrolyte fuel cells. After reviewing some of the requirements of metal hydrides for hydrogen fueled vehicles, the paper presents new results on the structure and hydrogen sorption properties of high storage capacity ball-milled magnesium hydride. The great advantages of milling the hydride instead of the pure metals for producing novel nanostructures with high surface area and for improving hydrogen sorption kinetics are presented. In the second part of the paper, the same technique has been extended to the milling of carbides and chlorides and coupled to a leaching process to produce new electrocatalysts for polymer electrolyte fuel cells. This new technology offers the possibility of producing nanoparticles with metastable structures whose specific surface area is much larger than that of any nanocrystalline powders made by conventional ball milling techniques. Pt-based nanoparticles were fabricated and tested as anode in fuel cells under pure and CO-contaminated hydrogen feedstreams.

### [32] MECHANOCHEMICAL INTERACTION OF PHENASAL WITH NATURAL AND SYNTHETIC POLYMERS [RUSSIAN]

Aiyumbetov MZ. Kristallovich EL. Karimov RK. Aripov KN. - *Khimiya Prirodnikh Soedinenii.* (6):834-835, 1998.

**[31] MECHANOCHEMICAL SYNTHESIS OF LEAD ZIRCONATE TITANATE FROM MIXED OXIDES**

Xue JM. Wan DM. Lee SE. Wang J. - Journal of the American Ceramic Society. 82(7):1687-1692, 1999  
High-density lead zirconate titanate (PZT) ceramics have been successfully prepared by using a novel mechanochemical fabrication technique, which skips the phase-forming calcination at an intermediate temperature that is always required in the industrial processes currently in use. The fabrication technique starts with mixing of the low-cost industrial oxide powders, and the designed PZT perovskite phase is formed by reacting the oxide constituents in a mechanochemical chamber that consists of a cylindrical alumina vial and one stainless-steel ball inside it. The solid-state reaction among constituent oxides is activated via mechanical energy instead of high temperature. When mechanochemically activated for 20 h, an ultrafine PZT powder of perovskite structure with a minimized degree of particle agglomeration is obtained. The resulting PZT powder sinters to 99.0% of theoretical density at 1100 degrees C for 1 h. The sintered PZT ceramic exhibits a dielectric constant of 1340 and a dielectric loss of 0.6% at a frequency of 1 kHz at room temperature.

**[30] COMBINED EFFECT OF PARTIAL CALCINATION AND SINTERING CONDITION ON LOW LOSS MN-ZN FERRITE**

Song KH. Park JH. - Journal of Materials Science-Materials in Electronics. 10(4):307-312, 1999  
In order to achieve highly densified lower loss Mn-Zn ferrite materials, various powder processing routes have been under investigation. In this report, a lower sintering temperature with lower oxygen partial pressure and proper attrition milling duration are suggested. From the previous study, a partial calcination procedure was studied and an optimum partial calcination level was found. Accordingly,  $Mn_{0.71}Zn_{0.22}Fe_{2.07}O_4$  ferrite was prepared by 1/2 calcination with small amounts of  $CaCO_3$ ,  $SiO_2$ ,  $Nb_2O_5$  and  $SnO_2$ . The partially calcined ferrites were made by calcining the mixture of the whole amount of ZnO and 1/2 amount of  $Fe_2O_3$  and  $Mn_3O_4$  and sintering the mixture of the calcined powders and the remaining 1/2 of  $Fe_2O_3$  and  $Mn_3O_4$ . Initially, from the 40 min secondary milling and the 1/2 partial calcination, lower temperature (1300 degrees C) sintered samples showed a power loss of similar to 340 mW  $cm^{-3}$  at 90 degrees C. Secondly, several milling durations showed secondary milling had a more profound effect on magnetic properties than primary milling. The 20 min primary and 90 min secondary milling showed lower core loss around 320 mW  $cm^{-3}$  at 1300 degrees C and 1250 degrees C, suggesting the sintering temperature could be reduced to 1250 degrees C. Thus, the proper sintering condition of lower oxygen partial pressure at 1250 degrees C was studied. As a result, lower loss with higher density was realized.

**[29] ATOMIC STRUCTURE, MAGNETISM, AND TRANSPORT PROPERTIES OF DAMAGED  $La_{0.67}Ca_{0.33}MnO_3$ -DELTA PROCESSED VIA HIGH-ENERGY BALL MILLING**

Liou MB. Islam S. Fatemi DJ. Browning VM. Gillespie DJ. Harris VG. - Journal of Applied Physics. 86(3):1607-1610, 1999  
A  $La_{0.67}Ca_{0.33}MnO_3$ -delta alloy was produced via a low-temperature solid state reaction in a high-energy ball mill. The milled alloy is found to exhibit the paramagnetic-to-ferromagnetic (P-F) transition at 150 K. However, the widely reported insulator-to-metal (I-M) transition that usually accompanies the P-F transition is totally suppressed. Anneals at 500-1000 degrees C in air ( $t = 8$  h) are found to lower the resistivity but not restore the I-M transition. The suppression of the I-M transition is attributed to anion defects in the structure that have not been annihilated during heat treatments. Extended x-ray absorption fine structure is employed to track the evolution of the atomic structure around the Mn cations at various stages of processing.

**[28] THE MICROSTRUCTURE RESEARCH OF SUPERSATURATED SOLID SOLUTIONS, RECEIVED BY MECHANOCHEMICAL ALLOYING [RUSSIAN]**

Boldyrev VV. Tsybulya SV. Cherepanova SV. Kryukova GN. Grigor'eva TF. Ivanov EY. - Doklady Akademii Nauk. 361(6):784-787, 1998

**[27] TWO-PHASE COEXISTENCE REGION IN MECHANICALLY ALLOYED CU-FE: AN X-RAY ABSORPTION NEAR-EDGE STRUCTURE STUDY**

Schilling PJ. He JH. Tittsworth RC. Ma E. - Acta Materialia. 47(8):2525-2537, 1999  
A new technique using the X-ray absorption near-edge structure (XANES) has been developed to simultaneously determine the compositions and phase fractions of the two coexisting (f.c.c. and b.c.c.) supersaturated solid solutions in mechanically alloyed  $Cu_{100-x}Fe_x$  ( $x = 50-80$ ) formed by ball milling under cryogenic conditions. The XANES analysis indicates that throughout this region the two coexistent phases have almost identical composition, consistent with that of the overall mixture. This represents a novel two-phase coexistence representing a region of overlap in solubility rather than the normal miscibility gap. A mechanism is proposed to explain the nature of this two-phase region in terms of extended solubility induced by ball milling, the free energies of the two phases including defect enthalpies, and nucleation and growth barriers for the b.c.c.-f.c.c. (and f.c.c.-b.c.c.) transformation.

**[26] SYNTHESIS AND CHARACTERIZATION OF MECHANICALLY ALLOYED AND SHOCK-CONSOLIDATED NANOCRYSTALLINE NiAl INTERMETALLIC**

Chen T. Hampikian JM. Thadhani NN. - Acta Materialia. 47(8):2567-2579, 1999  
The synthesis, microstructural characterization and microhardness of nanocrystalline B2-phase NiAl intermetallic are discussed in this paper. Nanophase NiAl powders were prepared by mechanical alloying of elemental Ni and Al powders under an argon atmosphere for different times (0-48 h). The alloyed nanocrystalline powders were then consolidated by shock compaction at a peak pressure of 4-6 GPa, to 83% dense compacts. Characterization by transmission electron microscopy (TEM) revealed that the microstructure of the shock-consolidated sample was retained at the nanoscale. The average crystallite size measurements revealed that mechanically alloyed NiAl grain size decreased from 48 +/- 27 to 9 +/- 3 nm with increasing mechanical alloying time from 8 to 48 h. The long-range-order parameters of powders mechanically alloyed for different times were determined, and were observed to vary between 0.82 for 5 h and 0.63 for 48 h of milling time. Following shock compaction, the long-range-order parameter was determined to be 0.76, 0.69 and 0.66, respectively, for the 16, 24 and 48 h alloyed specimens. Both the mechanically alloyed nanocrystalline NiAl powder and the shock-consolidated bulk specimen showed evidence of

grain boundary dislocations, subgrains, and distorted regions. A large number of grain boundaries and defects were observed via high resolution TEM (HRTEM). Shear bands were also observed in the mechanically alloyed NiAl intermetallic powders and in the shock-consolidated compacts. Microhardness measurements of shock-consolidated material showed increasing microhardness with increasing crystallite size refinement, following Hall-Fetch behavior.

**[25] MECHANOACTIVATED REACTIONS OF HALOGEN SUBSTITUTION IN ALKYLHALIDES VI. HALOGEN SUBSTITUTION IN ETBR ON THE SURFACE OF MECHANICALLY ACTIVATED KCL SALT [RUSSIAN]**

Mitchenko SA. Dadali YV. - Zhurnal Organicheskoi Khimii. 35(3):375-379, 1999

**[24] POTENTIAL MECHANO-CHEMICAL SYNTHESIS OF CALCIUM, STRONTIUM AND BARIUM ZIRCONATES [RUSSIAN]**

Marchev VM. Gospodinov GG. Stoyanov DG. - Zhurnal Obshchei Khimii. 69(3):371-373, 1999

**[23] STRUCTURAL CHARACTERIZATION OF FECRP-TYPE MESOSCOPIC SYSTEM**

Mihalca I. Morariu M. Lita M. Bibicu I. Ercuta A. Luca D. - Journal of Magnetism & Magnetic Materials. 201:53-57, 1999

The paper describes the structural properties of some Fe<sub>80-x</sub>Cr<sub>x</sub>P<sub>20</sub> (1 less than or equal to x less than or equal to 7) mesoscopic (similar to 1 μm) particles produced by mechanical alloying. The influence of the atomic concentration of Cr and that of the milling time are examined. The hyperfine field distribution obtained from the room temperature Mossbauer spectra of the as-milled samples exhibits three well separated peaks, associated with different chemical short range order, and depending on the atomic concentration of Cr atoms.

**[22] VUV REFLECTANCE SPECTROSCOPY STUDY OF FE CU ALLOYING**

Suave RN. de Castro ARB. - Journal of Electron Spectroscopy & Related Phenomena. 103(Special Issue SI):653-655, 1999

We present here the results of vacuum ultraviolet (VUV) reflectance measurements performed on Fe<sub>30</sub>Cu<sub>70</sub> alloyed by high-energy milling. The results show that true alloying occurs at the atomic level, and a change in the Fermi level of the system accompanying the alloying progress is observed. This is in reasonable agreement with theoretical calculations.

**[21] PRODUCTION OF PARTICLES OF EXPLOSIVES**

Teipel U. - Propellants, Explosives, Pyrotechnics. 24(3):134-139, 1999

The particulate properties of the particles in solid propellant and explosive charges are of very special importance. Depending on the properties of the substances involved, recrystallization of particles of explosives is carried out using different process technologies. Alongside milling, spray crystallization and crystallization out of solutions, new procedures such as crystallization using compressed gases and emulsion crystallization are finding increasing application.

**[20] FORMATION OF AMORPHOUS POWDERS OF ALLOYS OF THE CU-TI SYSTEM WITH MECHANICAL ACTIVATION OF POWDER MIXTURES**

Savin VV. Chaika VA. - Powder Metallurgy & Metal Ceramics. 37(7-8):448-451, 1998

The active mechanical treatment (AMT) of powder mixtures of the Cu-Ti system in a high-power mill and in a medium-power vibrating ball mill in argon allows one to synthesise the phases and to obtain the powders in an amorphous (by X-ray measurements) state. AMT of mixture proceeds via the following stages: grinding of precursor powders, formation of a layered structure, interdiffusion (mass transfer), and attainment of an amorphous state.

**[19] PROCESSING PARAMETER EFFECTS ON THE REACTION BONDING OF ALUMINUM OXIDE PROCESS**

Suvaci E. Messing GL. - Journal of Materials Science. 34(13):3249-3261, 1999

The reaction bonding of aluminum oxide (RBAO) process was analyzed from the milling of the precursor mixtures to the sintering of the reaction bonded alpha-alumina as a function of precursor powder composition, Al particle size, temperature, and heating rate. The RBAO process involves both solid-gas (T < T-M,T-Al) and liquid-gas (T > T-M,T-Al) oxidation of Al + alpha-Al<sub>2</sub>O<sub>3</sub> powder compacts. It has been demonstrated that maximum Al content of the precursor powder is limited to 60 vol %. In addition, it was observed that the initial Al particle size affects the oxidation behavior significantly and hence final properties of alpha-Al<sub>2</sub>O<sub>3</sub> compacts. Therefore, the initial Al particle size is very critical for the RBAO process. The critical Al particle size (i.e., the largest Al particle size can be used to obtain dense ceramic materials by the RBAO process) was determined as similar to 1.5 μm. It has been demonstrated that heating rate can be used to improve the final microstructures of RBAO ceramics. Although there is no large (>4 vol %) amount of ZrO<sub>2</sub> addition, alpha aluminum oxide ceramics with 97% TD have been produced by optimizing the processing parameters such as fine (<1.5 μm) Al particles and slower heating rate during the liquid-gas oxidation.

**[18] XRD, HRTEM AND XAFS STUDIES ON STRUCTURAL TRANSFORMATION BY MILLING IN A MIXTURE OF CUO AND CR2O3 AS AN ACTIVE CATALYST COMPONENT FOR LOW-TEMPERATURE METHANOL SYNTHESIS**

Ohyama S. Kishida H. - Applied Catalysis A-General. 184(2):239-248, 1999

The effect of milling is investigated on structural changes in a physical mixture of CuO and Cr<sub>2</sub>O<sub>3</sub> (denoted as CuO/Cr<sub>2</sub>O<sub>3</sub>), which is used as an active catalyst component for the low-temperature methanol synthesis via methyl formate. Detailed characterization of CuO/Cr<sub>2</sub>O<sub>3</sub> by different techniques such as N<sub>2</sub> adsorption, X-ray diffraction (XRD), high-resolution transmission electron microscopy with elemental analysis (HRTEM/EDX) and X-ray absorption fine structure (XAFS) reveals that long-term milling causes intimate contact between fine grains of CuO and Cr<sub>2</sub>O<sub>3</sub> and lattice disorder in CuO crystallites. No formation of any new compounds or solid solutions from CuO and Cr<sub>2</sub>O<sub>3</sub> is ascertained in milled CuO/Cr<sub>2</sub>O<sub>3</sub>. The results suggest that both effects, i.e., increased interfaces between CuO and Cr<sub>2</sub>O<sub>3</sub> and enlarged lattice disorder in CuO, contribute to the enhanced catalytic performance for the methanol synthesis. The combined results of HRTEM and XAFS analysis show that the crystallographic disorder proceeded on the edges of CuO grains.

**[17] MANGANESE ARSENIDE SYNTHESIZED BY MECHANICAL ALLOYING**

Wee L. McCormick PG. Street R. - Scripta Materialia. 40(11):1205-1208, 1999

**[16] EFFECT OF NITROGEN ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURE OF HOT ISOSTATICALLY PRESSED NANOGRAINED FE**

Munitz A. Livne Z. Rawers JC. Adams JS. Fields RJ. - Nanostructured Materials. 11(2):159-177, 1999

The effect of nitrogen content in Fe powders on the mechanical properties and microstructure of cold isostatic pressed (CIPed) and sintered or hot isostatic pressed (HIPed) Fe powders which was produced by attrition ball milling was investigated. Microhardness and compression tests were used to determine the mechanical properties. Optical, scanning, and transmission electron microscopy were used to investigate the microstructural changes that occurred during consolidation. Sintering of the CIPed bodies at temperatures below 850 degrees C caused no change in density, with only minor mechanical properties improvement, and the bodies remained friable. HIPing was found to be essential for effective consolidation of ball-milled powders. Increasing HIPing temperatures increased the density, the compression yield stress, the maximum compressive strength, and the hardness to a maximum value and then decreased. The maximum in density preceded the maximum in the compression yield stress, and its value depends on the nitrogen content in the powder. At low HIPing temperatures (<580 degrees C) the nitrogen content has no influence on the mechanical properties. However, above 580 degrees C, the nitrogen content reduces the mechanical properties as well as density, and increases the oxide precipitation. There are two microstructural effects of nitrogen on the microstructure: void formation in the Fe bodies HIPed above 580 degrees C for the higher nitrogen concentrations, and severe grain boundary embrittlement above 965 degrees C. Iron bodies processed in argon have smaller grain size than iron bodies processed in nitrogen throughout the entire consolidation temperature range. However, due to the smaller grain size, the optimum in mechanical properties (maximum strength with reasonable elongation) is reached only above 965 degrees C. Processing in argon improves machinability.

**[15] SINTERING OF BIMODAL Y2O3-STABILIZED ZIRCONIA POWDER MIXTURES WITH A NANOCRYSTALLINE COMPONENT**

Moskovits M. Ravi BG. Chaim R. - Nanostructured Materials. 11(2):179-185, 1999

Y2O3 - stabilized zirconia powders with average particle size of 10 nm and 430 nm were used to prepare bimodal powder mixtures by ultrasonic, ball milling and chemical precipitation techniques. Compacts were sintered between 1000 degrees C to 1340 degrees C for 10 min, 1 and 5h. German's packing model was used to describe the observed green and sintered density as well as to characterize the homogeneity of the compacts. The residual porosity was related to the non-homogeneous character of the porosity in the green bimodal compacts. Bimodal composition of 70 vol% coarse at 1200 degrees C yielded the highest densification rate during sintering.

**[14] LOW TEMPERATURE MECHANOCHEMICAL FORMATION OF TITANIUM CARBONITRIDE**

Kerr A. Welham NJ. Willis PE. - Nanostructured Materials. 11(2):233-239, 1999

The formation of a sub-micron sized powder composed of nanocrystalline alumina and titanium carbonitride of two different stoichiometries during high energy ball milling is reported in this paper. The starting materials were rutile (TiO2), graphite and aluminium powder. A similar composite with iron was also produced using the mineral ilmenite (FeTiO3) as the starting material. The powders were ball milled together under a nitrogen atmosphere for 100 h in a laboratory scale mill and subjected to thermal analysis and isothermal annealing at up to 1200 degrees C. X-ray diffraction showed that the phases were formed during the milling step and underwent grain growth and then reaction upon annealing. Differential thermal analysis indicated no residual elemental aluminium after milling confirming that the reaction was complete within the mill.

**[13] SYNTHESIS AND MAGNETIC PROPERTIES OF NANOSTRUCTURED GAMMA-NI-Fe ALLOYS**

Qin XY. Kim JG. Lee JS. - Nanostructured Materials. 11(2):259-270, 1999

Nanostructured gamma-Ni-xFe alloys with x approximate to 32, 46, 55, and 64wt% and with an average grain size of 30-40nm were successfully synthesized by a mechano-chemical process. Magnetic measurements indicated that these nano-alloys were ferromagnetic; no superparamagnetic phenomenon was observed at all the temperatures investigated (from similar to 300K to 8.5K). The coercivity of these nano-alloys were much higher than that of their conventional coarser-grained counterparts, implying that random anisotropy did not dominate their magnetic behavior although their grain sizes were substantially smaller than the evaluated magnitudes of the ferromagnetic exchange lengths. The increase of coercivity and retentivity with iron content, as  $x < 55\text{wt}\%$ , was found to be: basically proportional to magnetocrystalline anisotropy in the Ni-Fe system, indicating magnetocrystalline anisotropy was the dominant factor. As  $x > 55\text{wt}\%$ , however, the decrease of coercivity with iron content was far slower than one would expect based on the crystalline anisotropy. Microstructural analysis indicated that the high coercivity for the nano gamma-Ni-Fe with higher iron content ( $x = 64\text{wt}\%$ ) can be explained by its larger shape anisotropy. The variation of the saturation magnetization of the nano gamma-Ni-xFe alloys with iron content are basically similar to that of its polycrystalline counterpart. But, the absolute magnitudes were about 11-13% lower than those of the corresponding polycrystalline counterparts. This slight decrease in magnitude can be ascribed to oxidation of the nano gamma-Ni-xFe powder after reduction.

**[12] EFFECT OF SUPERCRITICAL DRYING METHOD ON MICROSTRUCTURE AND PROPERTIES OF AL2O3 COMPOSITES REINFORCED WITH ULTRAFINE SiC PARTICULATE [JAPANESE]**

Nakahira A. Murao T. Takeda S. Tajika M. Sekino T. Choa YH. Niihara K. - Nippon Seramikkusu Kyokai Gakujutsu Ronbunshi-Journal of the Ceramic Society of Japan. 107(5):460-464, 1999

Mixtures of 95 vol% ultrafine gamma-Al2O3 powder and 5 vol% ultrafine SiC powder, with average particle size of 40 nm, were mixed wet-ball milling and prepared by drying their slurry with a supercritical drying method and a microwave drying method. Al2O3 specimens dispersed with ultrafine-SiC particles as the secondary phase were hot-pressed, their powders being prepared by both the above drying methods. Difference between the supercritical drying and the microwave drying method on the microstructure of Al2O3/5 vol%SiC composites was investigated. Dense Al2O3/SiC composites were obtained at lower hot-pressing temperatures when the mixture was prepared by

supercritical drying method, Influence of the drying method on the gamma- to alpha-Al<sub>2</sub>O<sub>3</sub> transition behavior was also examined. Al<sub>2</sub>O<sub>3</sub>/SiC powder dried by the supercritical drying method showed narrow particle size distribution and the formation of soft agglomerates, Al<sub>2</sub>O<sub>3</sub>/SiC composite sintered by hot-pressing the powder dried with the supercritical drying method indicated relatively higher strength, whereas the strength of Al<sub>2</sub>O<sub>3</sub>/SiC composite through microwave drying method was low and had the large scatter.

**[11] MECHANOCHEMICAL SYNTHESIS OF CHROMIUM BORIDES**

Iizumi K. Kudaka K. Maezawa D. Sasaki T. -Nippon Seramikkusu Kyokai Gakujutsu Ronbunshi-Journal of the Ceramic Society of Japan. 107(5):491-493, 1999

Chromium and boron compounds have potential for structural applications which require high temperature strength because of their high melting point, chemical stability, hardness and strength. Ball-milling of elemental powder mixtures without external heat application has been processed as a mechanism for the mechanochemical synthesis of high melting point compounds. Chromium and amorphous boron elemental powder mixtures at atomic ratios of 1 : 1 and 1 : 2 were processed for 10-40h in a planetary ball-mill. CrB<sub>2</sub> was formed at a low yield after 10-30h of milling the 1 : 2 mixture using tungsten carbide balls. However, a single phase of CrB<sub>2</sub> was found by XRD, after the as-milled Cr-B (1 : 2) mixture was annealed at 900 degrees C for 2h. A single phase of CrB was formed by annealing the Cr-B (1 : 1) mixture at 1000 degrees C for 2h. Ball-milling of the elemental powder mixtures before annealing significantly reduced the reaction temperature necessary for chromium boride synthesis. The as-milled Cr-B (1:2) mixture contained fewer contaminations (tungsten and cobalt) than the as milled Cr-B (1:1) mixture. The lattice parameters of the chromium borides obtained agree with previously reported measurements.

**[10] HYDROGEN STORAGE CHARACTERISTICS OF BALL-MILLED MAGNESIUM-NICKEL AND MAGNESIUM-IRON ALLOYS**

Holtz RL. Imam MA. - Journal of Materials Science. 34(11):2655-2663, 1999

Of potential hydrogen storage materials, pure magnesium would be best from the standpoint of hydrogen capacity per unit mass. However, pure magnesium has poor hydriding kinetics. Alloying magnesium with nickel and other transition metals aids catalysis of the hydrogen dissociative chemisorption and yields other benefits by lowering the dehydrogenation temperature, although at the expense of decreased storage capacity. Magnesium-nickel alloys with about one percent nickel prepared by ball-milling yield the most significant improvements in hydrogen storage behavior relative to pure magnesium.

**[9] CHARACTERIZATION OF NANOCRYSTALLINE FE-45 AT% AL INTERMETALLIC POWDERS OBTAINED BY CONTROLLED BALL MILLING AND THE INFLUENCE OF ANNEALING`**

Varin RA. Bystrycki J. Calka A. - Intermetallics. 7(8):917-930, 1999

An ingot of the binary Fe-45 at% Al intermetallic with ordered B2 crystallographic structure was machined into chips and ball milled under controlled shear conditions to produce powders with a nanocrystalline grain size. Some milled powders were additionally annealed at 600 degrees C. The average powder particle size decreased with milling time attaining 8 +/- 8 nm after 210 h of milling. Milled powders became strongly ferromagnetic. The B2 superlattice reflections in X-ray diffraction (XRD) were undetectable even after the shortest milling time of 23 h, indicating a complete disorder. Formation of nanocrystallites was confirmed by the XRD peak broadening and the XRD estimated nanocrystallite size decreased from 40 nm after 23 h to the 12-7 nm range after 47 to 210 h of milling. Lattice constant of powders increased during the first 23 h of milling, remaining approximately constant for longer milling times. This change is attributed to the formation of antisite-atom pairs. An attempt has been made to correlate the microhardness of milled powders (disordered BCC solid solution) with their nanocrystalline grain size through the Hall-Petch (H-P) relationship:  $HV_{0.01} = 603.6 + 279.8d^{-0.5}$  (kg mm<sup>-2</sup>) where HV<sub>0.01</sub> is Vickers microhardness at 0.01 kg and d is nanocrystalline grain size in nm. The data fit was very poor (R<sup>2</sup> = 0.49 only). The relationship is very weak as indicated by a small value of the H-P slope. The "inverse" H-P relationship for the finest nanocrystallites cannot be entirely ruled out. After annealing at 600 degrees C the relative long range order (LRO) parameter, S, was not fully restored to similar to 1.0 but attained a value similar to 0.8-0.9 while both microhardness and lattice constant were slightly higher than those of the homogenized B2 Fe-45Al intermetallic. These changes are attributed to the existence of some "residual" antisite-atom pairs retained after annealing. DTA studies of milled powders show two exothermic peaks with their maxima at 190 and 850 degrees C, The low-temperature peak is attributed to the ferromagnetic to paramagnetic transition and a simultaneous disorder/order transformation. The high-temperature one is probably related to the recrystallization and/or nanocrystallite grain growth.

**[8] EFFECT OF ATTRITOR MILLING ON THE DENSIFICATION OF MAGNESIUM ALUMINATE SPINEL**

Sarkar R. Das SK. Banerjee C. - Ceramics International. 25(5):485-489, 1999.

Densification of magnesium aluminate spinel was studied with both the single stage and double stage sintering processes using attritor mill for the reduction of particle size. Presynthesized spinel and a stoichiometric mixture of calcined magnesia and alumina were used for the study. Presynthesization of spinel and calcination of raw materials were done at 1400 and 1600 degrees C. Milling was done for 2, 4 and 6 h. Extent of milling was characterised by measuring the specific surface area of the milled powders. Densification was found to be greatly influenced by milling. A maximum 99.5% densification was obtained.

**[7] SYNTHESIS OF SOL-GEL DERIVED ALUMINA POWDER: EFFECT OF MILLING AND CALCINATION TEMPERATURES ON SINTERING BEHAVIOUR**

Sathiyakumar M. Gnanam FD. - British Ceramic Transactions. 98(2):87-92, 1999

Boehmite powder has been prepared by hydrolysing aluminium iso-propoxide and peptising with nitric acid. This amorphous boehmite undergoes a series of phase transitions (gamma-AlOOH --> gamma-Al<sub>2</sub>O<sub>3</sub> --> delta-Al<sub>2</sub>O<sub>3</sub> --> alpha-Al<sub>2</sub>O<sub>3</sub>) on heating. Thermal analysis and phase determination using XRD and IR spectra of powder calcined at different temperatures confirmed the phase transitions. The effects of dry and wet milling on powder particle size, sinterability, and microstructure of sintered bodies have been studied. Compacts of wet milled powder calcined at 1000 degrees C attained 98% of theoretical density at 1600 degrees C.

**[6] ROLE OF INTERFACIAL STRUCTURE IN NANOSTRUCTURED ELEMENTAL METALS: A NEW THERMO-MECHANICAL PROCESS FOR THE PREPARATION OF NANOSTRUCTURED BINARY ALLOYS**

Grandi TA. dos Santos VHF. de Lima JC. - Solid State Communications. 110(12):673-677, 1999.

In this article we present the first results obtained for nanostructured gamma-Ni<sub>20</sub>Zn<sub>80</sub> alloy prepared by a thermo-mechanical (TM) process developed in our laboratory. The process uses the energy stored in the defect structure, generated via mechanical milling of the nickel, to accelerate the reaction in the solid state, allowing a more rapid alloy formation. The process presents several advantages, when compared with techniques currently used for the production of this class of materials. The X-ray diffraction pattern for the alloy produced by the TM process is compared with that measured for the same alloy, produced by the mechanical alloying technique. The results show that the TM process holds the potential to become a valuable alternative method for the production of nanostructured materials.

**[5] ENHANCED DISSOLUTION OF MINERALS: MICROTOPOGRAPHY AND MECHANICAL ACTIVATION**

Tromans D. Meech JA. - Minerals Engineering. 12(6):609-625, 1999

A theoretical evaluation of the role of microtopography in the phenomenon of mechanically activated dissolution of finely milled minerals has been undertaken. Attention was directed to the role of surface steps produced by fracture and abrasion of milled particles. It was estimated that the activation energy for dissolution at the edge of steps is at least 20% less than that for dissolution from terraces (flat regions) between the edges, leading to enhanced dissolution of steps. The relative rates of dissolution at steps and terraces depend upon the particular mineral/solution process chemistry through the effects of process temperature (T) and the magnitude of the activation energies for dissolution. Enhanced dissolution of particles containing stepped surfaces was modelled by including the fraction, alpha, of dissolution sites on step edges relative to the total number of surface dissolution sites. The fraction, alpha, is expected to be mineral-sensitive through the effects of fracture and cleavage behaviour on step formation. The mean diameter, D-M, of particles subject to enhanced dissolution by microtopography factors was shown to lie in the micron (mu m) to sub-micron range. This range is consistent with particle sizes where enhanced dissolution by mechanical activation has been reported.

**[4] Effect of particle size of powders ground by ball milling on densification of cordierite ceramics**

Nakahara M. Kondo Y. Hamano K. - Nippon Seramikkusu Kyokai Gakujutsu Ronbunshi-Journal of the Ceramic Society of Japan. 107(4):308-312, 1999

Mixtures of calcined kaolin, calcined talc and alumina were ground to submicron particle size by ball milling, and the effect of particle size of the ground mixtures on the densification behavior of a cordierite sintered body was studied. As the particle size of the ground mixtures became smaller, the raw material powders were mixed more uniformly and the formation temperature of alpha-cordierite became lower. Dense and pore-free sintered bodies were obtained by firing ground mixtures with particle size smaller than 0.39 mu m at temperatures as low as 1200 degrees C. Cordierite sintered bodies prepared from mixtures with particle size 0.39 mu m or smaller by grinding natural raw materials had bending strengths ranging from 140-160 MPa, and these values were larger than that of cordierite glass ceramics reported by Hayashi et al.(1)) The thermal expansion coefficients of dense, high-strength cordierite bodies increased, because anisotropic thermal expansion could not lower the amount of thermal expansion in the pore-free body.

**[3] STRUCTURE AND MAGNETIC PROPERTIES OF ND-FE-B/ALPHA-FE NANOCOMPOSITE MAGNETS BY CO, NB, DY SUBSTITUTIONS**

Zhang J. Sun XK. Liu W. Cui BZ. Zhao XG. Zhang ZD. - Journal of Materials Science & Technology. 15(3):198-202, 1999

Structure and magnetic properties of the nanocomposite magnets prepared by mechanical alloying procedure with composition 55 wt pct Nd (Fe<sub>0.92</sub>B<sub>0.08</sub>)(5.5)+45 wt pct alpha-Fe, 55 wt pct Nd(Fe<sub>0.8-x</sub>Co<sub>0.12</sub>Nb<sub>x</sub> B-0.08)(5.5)+45 wt pct alpha-Fe (x=0.00, 0.01, 0.03) and 55 wt pct (Nd<sub>0.9</sub>Dy<sub>0.1</sub>) (Fe<sub>0.77</sub>Co<sub>0.12</sub>Nb<sub>0.03</sub>B<sub>0.08</sub>)(5.5)+45 wt pct alpha-Fe were studied. It was found that substitution of Co for Fe could significantly improve the permanent magnetic properties of the nanocomposite magnets and typically, the maximum magnetic energy product was increased from 104.8 kJ/m<sup>3</sup> (13.1 MGOe) to 141.6 kJ/m<sup>3</sup> (17.7 MGOe). In contrast to the case of conventional nominally single-phase magnets, the addition of Nb results in promoting the growth of alpha-Fe grain and is thus unfavorable for the improvement of permanent magnetic properties of the nanocomposites. Although the addition of Dy can increase the coercivity of the magnets, the increase of magnetic anisotropy of hard phase leads to decrease of the critical grain size of soft phase. Additionally it causes the difficulty of preparing the nanocomposites because it is more difficult. to control the grain size of soft phase to meet the requirement of appropriate exchange coupling between hard and soft grains.

**[2] THE ROLE OF TITANIA SUPPORT IN MO-BASED HYDRODESULFURIZATION CATALYSTS**

Ramirez J. Cedeno L. Busca G. - Journal of Catalysis. 184(1):59-67, 1999

A series of mechanical mixtures Mo/Al<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub> has been prepared to study the role of titania in Mo-based HDS catalysts. The catalysts were tested in the thiophene hydrodesulfurization reaction at atmospheric pressure and were characterized by UV-vis diffuse reflectance spectroscopy (DRS), TPR-S (after reaction), and high-resolution electron microscopy (HREM). The results show that the titanium species formed during sulfidation and HDS reaction act as promoter of the Mo phase giving rise to a synergy effect. This synergy effect seems to be related to the electronic properties of the partially reduced and/or sulfided TiO<sub>2</sub> surface and, in particular, to the presence of Ti<sup>3+</sup> ions. Finally, estimation of the number of sulfur vacancies created on the used catalysts during TPR-S indicate that only a small proportion of all the edge/corner Mo atoms present in the MoS<sub>2</sub> crystallites, estimated from HREM observations, are active in HDS and that a low number of sulfur vacancies are required.

**[1] MORPHOLOGICAL OBSERVATION OF THE MECHANICALLY ALLOYING (Bi<sub>2</sub>O<sub>3</sub>)(0.80)(Nb<sub>2</sub>O<sub>5</sub>)(0.20)**

Takai S. Shiraishi N. Atake T. Esaka T. - Electrochemistry. 67(5):466-469, 1999 May.

The mechanical alloying (MA) process of the oxide ion conductor (Bi<sub>2</sub>O<sub>3</sub>)(0.80)(Nb<sub>2</sub>O<sub>6</sub>)(0.20) has been studied by

means of X-ray diffraction, SEM observation and particle size measurements. The formation of the solid solution was supposed to proceed by flattening the sample powders into plate shapes and the repeated laminations as the case of the formation of metallic alloys. During milling, the crystallite size decreases down to 10 nm or smaller while the aggregated particle size was remaining about 1  $\mu$  m.

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