



Reviews on Advanced Materials Science

Volume 18, Number 3, August 2008

Editorial Policy:

Reviews on Advanced Materials Science provides an international medium for the publication of reviews, topical issues and international conference proceedings in the area of theoretical and experimental study of advanced materials. Focuses are placed on, but not limited to nanostructured materials, semiconductors and materials for hydrogen economy. We encourage prospective authors to correspond with the Editor-in-Chief before submitting a review article. Proposals should include an outline with key citations. All papers submitted will be rigorously peer-reviewed prior to publication. **Reviews on Advanced Materials Science** is published in both paper and electronic versions.

Abstracting and Indexing:

Reviews on Advanced Materials Science is covered in *ISI Science Citation Index Expanded (SCIE)*; *ISI Current Contents/Physical, Chemical & Earth Sciences (CC/PC&ES)*; *ISI Materials Science Index*; *Cambridge Scientific Abstracts*; *Chemical Abstracts*; *Elsevier Bibliographic Databases*; and *Institut de l'Information Scientifique et Technique – Centre National de la Recherche Scientifique (INIST-CNRS)*.

CONTENTS

Foreword to ISMANAM 2006	A5
ISMANAM 2006 participants photo	A6
Foreword to Henryk Matyja Memorial Session	A7
Mechanical Alloying and Consolidation, Part 1	A9
Recent Developments in Mechanical Alloying	203
C. Suryanarayana	
Mechanochemical Reduction of Antimony Sulphide Sb₂S₃ With Magnesium in a Planetary Mill	212
E. Godočíková, L. Takacs, P. Baláž, J. Kováč, A. Šatka and J. Briančin	
Influence of Soluble Salt Matrix on Mechanochemical Preparation of PbS Nanoparticles	216
M. Achimovičová, E. Godočíková, P. Baláž, J. Kováč and A. Šatka	
Devitrification of Mechanically Alloyed Zr-Ti-Nb-Cu-Ni-Al Glassy Powders Studied by Time-Resolved X-ray Diffraction	221
S. Scudino, D. J. Sordelet and J. Eckert	
Ball Milling in the Presence of a Fluid: Results and Perspectives	225
D. Guérard	
XRD and TEM Characterization of Al-Mg-Based Nanocomposite Alloys	231
N. Al-Aqeeli, G. Mendoza-Suarez and R.A.L. Drew	
The Synthesis of Titanium Alloys for Biomedical Applications	236
K. Niespodziana, K. Jurczyk and M. Jurczyk	
Investigation of the Structure Kinetics of Crystallization Cu_{45+x}Ti_{55-x} Alloys Prepared by Mechanical Alloying Technique	241
M.S. Al-Assiri, A. Alolah, A. Al-Hajry and M. Bououdina	
Cu-Al/Al₂O₃ Cermet Synthesized by Reactive Ball Milling of CuO-Al System	248
K. Wieczorek-Ciurowa, D. Oleszak and K. Gamrat	
Formation and Magnetic Properties of Co-M-Ti-B (M=Fe, Nb) Amorphous Powders by Mechanical Solid-State Reaction	253
H.-M. Wu, Ch.-J. Hu and Y.-D. Cheng	
Metallic Glass Formation in NiTiZrNbSi Alloys by Rapid Solidification or Ball Milling and Ultra High Pressure Compaction	257
J. Dutkiewicz, L. Lityńska, W. Maziarz, M. Parra Carrillo, I. Mercioniu and L. Jaworska	
Structure of Nanocrystalline Ti-base Alloys Obtained by Mechanical Alloying and Ultra High Pressure Sintering	264
J. Dutkiewicz, W. Maziarz and L. Jaworska	
Reaction Milled and Spark Plasma Sintered Al-AlB₂ Composite Materials	269
M. Kubota and M. Sugamata	
Mechanical and Structural Characterization of Graphite Coated Silver Nanoparticles-Reinforced Aluminum	276
P.G. Ramírez-Cano, I. Estrada-Guel, D.C. Mendoza-Ruiz, J. Reyes-Gasga, M. J. Yacamán, A. Márquez-Lucero and R. Martínez-Sánchez	
Dispersion of Graphite Nanoparticles in a 6063 Aluminum Alloy by Mechanical Milling and Hot Extrusion	280
D. C. Mendoza-Ruiz, M. A. Esneider-Alcalá, I. Estrada-Guel, M. Miki-Yoshida, M. López-Gómez and R. Martínez-Sánchez	
Formation of Supersaturated Fe-Li Solid Solution by Mechanical Alloying	284
K. N. Ishihara, F. Kubo, E. Yamasue and H. Okumura	
Mechanosynthesis of Nanocrystalline Cu With Al₂O₃ Dispersion by Cryogenic Milling	289
J.-H. Lee and S. J. Hwang	

Sinterability of Mechanically Alloyed Ti-37.5Si (at.%) Powders Coated With a Metallic Thin Layer by Sputtering	293
F. Simões, N. Duarte and B. Trindade	
Consolidation of Mechanically Milled Al/Al₂O₃ and Al-8Zn/Al₂O₃ Composite Powders	297
D. Hernandez-Silva, J. Gamez-Huerta, M. A. Garcia-Bernal and V. Sauce-Rangel	
Comparative Study of Al-Ni-Mo Alloys Obtained by Mechanical Alloying in Different Ball Mills	301
M. I. Flores-Zamora, C. A. Martínez-Pérez, M. García-Guaderrama, I. Estrada-Guel, F. Espinosa-Magaña and R. Martínez-Sánchez	
Structure and Properties of Mechanically Alloyed Composite Materials From Hard-Recycling Scrap of Al Alloys	305
M. Samoshina, A. Aksenov and E. Kaevitser	
High Temperature Deformation of a Mg-Cu-Gd Bulk Metallic Glass: Impact of Partial Crystallization	311
S. Puech, J.J. Blandin and J.L. Soubeyroux	

PREFACE

From 27th till 31st August 2006, the International Symposium on Metastable and Nano Materials, previously named the International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials, was held in Warsaw, Poland. The 13th edition of ISMANAM was hosted by the Faculty of Materials Science and Engineering, Warsaw University of Technology. The event is the continuation of the tradition of meeting in spots all over the world – the first ISMANAM was organised in Grenoble in 1994, then followed by the meetings in Quebec, Rome, Sitges, Wollongong, Dresden, Oxford, Ann Arbor, Seoul, Foz do Iguacu, Sendai and Paris. In 2006, it was the first time when the participants of the event gathered in the country of the former Eastern Europe. During 13th ISMANAM, 223 participants from 33 countries from all the inhabited continents, presented the work of 707 authors, in the form of 3 plenary talks, 25 invited talks, 74 oral contributions and 134 posters. For these Proceedings, nearly 150 papers prepared by almost 480 authors were accepted and submitted for publication.

During over ten years of ISMANAM history, the scope has been significantly widened, the modification of the title of the Symposium to the present one being the evidence of these changes. The materials covered in the Symposium included, but were not limited to, amorphous, nanocrystalline, quasicrystalline and metastable crystalline ones. The scope of the Symposium encompassed metals, ceramics, intermetallics, polymers and composites. Also the form of the investigated items spanned from nanosized particles, through thin films, powders to bulk elements, including composites and nanocomposites. Various aspects of the materials science were discussed: modelling, manufacturing, characterisation of structure and properties, performance and applications. The participants presented the phenomena, relationships and observations, and shared their ideas and doubts, opening space to fruitful discussions. Theoretical and empirical approaches to the raised issues were presented, as well as the practical applications of the metastable and nanostructured materials.

The subjects of the reported works were divided into separate groups, presented in sessions covering: metallic glasses, bulk metallic glasses, crystallisation, mechanical alloying, powders consolidation, magnetic materials, hydrogen storage, electrochemical properties, structure characterisation and others.

Traditionally, the ISMANAM Steering Committee acknowledged the outstanding achievements of a senior and a junior scientist by granting the awards. The Senior Researcher Award was handed to Prof. Takeshi Egami of the University of Tennessee, and the Junior Researcher Award went to Dr. Howard W. Sheng of the Johns Hopkins University.

The ISMANAM Steering Committee accepted the proposal of Prof. Georgios A. Evangelakis to organise the next Symposium in Corfu, Greece. For the Symposium in 2008, the Committee provisionally accepted the proposals of Prof. Fernando Audebert (Argentina) and Prof. Jiangzhong Jiang (China).

We wish to express our sincere thanks to all these who contributed to the success of 13th ISMANAM: the members of the Scientific Committee, the members of the National Advisory Committee, the session chairpersons, invited speakers and all the contributing participants. The efforts of the colleagues of the Local Organising Committee are gratefully acknowledged. The Organisers would like to thank Polish Ministry of Science and Higher Education and the Rector of Warsaw University of Technology for their financial support of the Symposium.

Warsaw, October 2007

Tadeusz Kulik, Chairman
Dariusz Oleszak
Jarosław Ferenc



Participants of the 13th International Symposium on Metastable and Nano Materials, August 2006, Warsaw, Poland.

Henryk Matyja Memorial Session



On Tuesday, 29th August, one of the plenary sessions was devoted to commemorate Professor Henryk Matyja, the pioneer of the research in the field of rapidly quenched and mechanically alloyed materials in Poland. The Symposium, held five years after He passed away, was a good opportunity to remember Him and His contribution to our present knowledge.

Henryk Matyja, born in 1923, graduated from the Mechanical Faculty of Warsaw University of Technology, and for all his professional life was with the Department of Physical Metallurgy, then with the Institute of Materials Science and Engineering, transformed into the Faculty of Materials Science and Engineering, WUT. As the academic teacher, He spent over a half of century at the university, focusing on teaching undergraduates and postgraduate students, and supervised 26 Ph. D. theses. His successors remain not only in Poland – they may be found as far as in the USA, Canada or Australia. Henryk Matyja was a Full Professor in Materials Science at Warsaw University of Technology since 1974.

Scientific activities of Professor Matyja were very extensive. He broke ground in Poland and the whole Eastern Europe in the area of metallic glasses, starting this research in early 1970's. Professor was the founder of the Amorphous and Nanocrystalline Materials Group, and its head for about 30 years. He published 4 monographs and about 200 papers. Abroad, Professor Matyja was a visiting scientist at the Department of Metallurgy of the Massachusetts Institute of Technology in 1961-1962 and 1965-1967. He was also a Visiting Professor at the Department of Metallurgical Engineering and Materials Science at the University of Notre Dame in 1982-1984 and 1986. Despite his age He remained remarkably active as a scientist.

Professor Matyja was known as the one who enjoyed travelling, trying good food, meeting people, touching various cultures. It was our pleasure to meet him every day to discuss not only the scientific issues, but also to share opinions and dispute on all aspects of life.

Professor Henryk Matyja died on 15th March 2001 at the age of 78, mourned by the international scientific community. As a friend and a professional, He will live in the memory of all of us forever.

During the Memorial Session, which was attended by Professor's wife, children, grandchildren, relatives and co-workers, Professor Matyja was reminisced by Andrzej Całka, Brian Cantor, Clara F. Conde, Wojciech Dmowski, Viktoria I. Fadeeva, Akihisa Inoue, Tadeusz Kulik, Peter Švec and Alain R. Yavari.

Mechanical Alloying and Consolidation,

Part 1

**ADVANCED STUDY CENTER.
TRANSFER OF COPYRIGHT AGREEMENT**

Article entitled:

Corresponding author:

To be published in the journal: "Reviews on Advanced Materials Science"

Effective upon acceptance for publication, copyright (including all rights thereunder and including the right to authorise photocopying and reproduction in all media, whether separately or as a part of a journal issue or otherwise) in the above article and any modifications of it by the author(s) is hereby transferred throughout the world and for the full term and all extensions and renewals, to:

"Advanced Study Center" Co. Ltd., (St. Petersburg, Russia)

This transfer includes the right to adapt the presentation of the article for use in conjunction with computer systems and programs, including reproduction or publication in machine-readable form and incorporation in retrieval systems.

Rights of authors

The following rights are retained by the author(s):

1. Patent and trademark rights and rights to any process or procedure described in the article.
2. The right to photocopy or make single electronic copies of the article for their own personal use, including for their own classrom use, or for the personal use of colleagues, provided the copies are not offered for sale and are not distributed in a systematic way outside of their employing institution (e.g. via an e-mail list or public file server). Posting of a preprint version of this work on an electronic public server is permitted. Posting of the published article on a secure network (not accessible to the public) within the author's institution is permitted. However, posting of the published article on an electronic public server can only be done with written permission of Advanced Study Center. Co. Ltd.
3. The right, subsequent to publication, to use the article or any part thereof free of charge in a printed compilation of works of their own, such as collected writings or lecture notes, in a thesis, or to expand the article into book-length form for publication.

Note

All copies, paper or electronic, or other use of the information must include an indication of the copyright ownership and a full citation of the journal source. *Please refer requests for all uses not included above, including the authorization of third parties to reproduce or otherwise use all or part of the article (including figures and tables) to:*

Reviews on Advanced Materials Science

Editorial Office

Institute of Problems of Mechanical Engineering Russian Academy of Sciences

Bolshoj 61, Vas.Ostrov, St.Petersburg 199178, Russia

E-mail: rams@def.ipme.ru Fax: +(7 812)321 4771

Authorship

If the article was prepared jointly with other author(s), the signing author has informed the co-author(s) of the terms of this copyright transfer and is signing on their behalf as their agent and represents that he or she is authorized to do so. Please confirm by marking the appropriate box following the signature line. The signing author shall bear the responsibility for designating the co-author(s) and must inform Advanced Study Center of any changes in authorship.

If copyright is held by the employer, the employer or an authorized representative of the employer must sign. If the author signs, it is understood that this is with the authorization of the employer and the employer's acceptance of the terms of the transfer. Please confirm by marking the appropriate box following the signature line.

Warranties

The author(s) warrant(s) that the article is the author's original work and has not been published before. The author(s) warrant(s) that the article contains no libelous or other unlawful statements, and does not infringe on the rights of others. If experts from copyrighted works are included, the author(s) has (have) obtained or will obtain written permission from the copyright owners and will credit the sources in the article.

Signature of copyright owner(s) *:

Name (printed):

Title (if employer representative):

Company or institution:

Date:

If any of the following apply, please mark the box(es):

author on behalf of all co-authors

employer representative

PLEASE SIGN IN INK AND RETURN THE COMPLETE **ORIGINAL** (do not send by fax), retaining a copy of this form for your files, TO:

Reviews on Advanced Materials Science

Editorial Office

Institute of Problems of Mechanical Engineering Russian Academy of Sciences

Bolshoj 61, Vas.Ostrov, St.Petersburg 199178, Russia

E-mail: rams@def.ipme.ru, Fax: +(7 812)321 4771

*To be signed by the author, also on behalf of any co-authors, or to be signed by employer, where appropriate.