



Volume 28
Issue 9
September 2007
Pages 513-576

Published since 1978
formerly as Archives of Materials Science
or Archiwum Nauki o Materiałach (in Polish)

Archives of Materials Science and Engineering



Editor-in-Chief Prof. Leszek A. Dobrzański

International Scientific Journal published monthly
as the organ of the Committee of Materials Science
of the Polish Academy of Sciences

<http://www.archivesmse.org>



PUBLISHED SINCE 1978 – formerly as Archives of Materials Science or Archiwum Nauki o Materiałach (in Polish)

Editor-in-Chief

Prof. Leszek A. Dobrzański Dr hc – Gliwice, POLAND

International Editorial Board Members

Prof. Waqar Ahmed – Ulster, UK
Prof. Davor Balzar – Denver, USA
Prof. Dorel Banabic – Cluj Napoca, ROMANIA
Prof. Zbigniew Bojarski Dr hc – Katowice, POLAND
Prof. Tadeusz Bołd – Gliwice, POLAND
Prof. Eduard Cesari – Palma de Mallorca, SPAIN
Prof. Tara Chandra – Wollongong, AUSTRALIA
Prof. Jan Chłopek – Cracow, POLAND
Prof. Antonio Cunha – Guimaraes, PORTUGAL
Prof. Jan Cwajna – Katowice, POLAND
Prof. Aleksandra Czyrska-Filemonowicz – Cracow, POLAND
Prof. Edward D. Doyle – Swinburne, AUSTRALIA
Prof. Georgy Drapak – Chmelnicki, UKRAINE
Prof. Jan Dutkiewicz – Cracow, POLAND
Prof. Guenther Eggeler – Bochum, GERMANY
Prof. Nikolaos Gouskos – Athens, GREECE
Prof. Maciej W. Grabski Dr hc – Warsaw, POLAND
Prof. Toshio Haga – Osaka, JAPAN
Prof. Abdel Magid Hamouda – Selangor, MALAYSIA
Prof. Stuart Hampshire – Limerick, IRELAND
Prof. Adam Hernas – Katowice, POLAND
Prof. Marek Hetmańczyk – Katowice, POLAND
Prof. Jan Van Humbeeck – Leuven, BELGIUM
Prof. Werner Hufenbach – Dresden, GERMANY
Prof. David Hui – New Orleans, USA
Prof. Yong-Taek Im – Daejeon, KOREA
Prof. Mark J. Jackson – West Lafayette, USA
Prof. Leopold Jeziorski Dr hc – Częstochowa, POLAND
Prof. Mieczysław Jurczyk – Poznań, POLAND
Prof. Jan Kazior – Cracow, POLAND
Prof. Peter Klimanek – Freiberg, GERMANY
Prof. Albert Kneissel – Leoben, AUSTRIA
Prof. Ivars Knets – Riga, LATVIA
Prof. Janez Kopač Dr hc – Ljubljana, SLOVENIA
Prof. Andrzej Korbel – Cracow, POLAND
Prof. Gernot Kostorz – Zuerich, SWITZERLAND
Prof. Piotr Kula – Łódź, POLAND
Prof. Tadeusz Kulik – Warsaw, POLAND
Prof. Krzysztof J. Kurzydłowski – Warsaw, POLAND
Prof. Karl Kuzman – Ljubljana, SLOVENIA
Prof. Jerzy Lis – Cracow, POLAND
Prof. Gordon W. Lorimer – Manchester, UK
Prof. Petr Louda – Liberec, CZECH REPUBLIC
Prof. Eugeniusz Łągiewka – Katowice, POLAND
Prof. Adolf Maciejny Dr hc – Katowice, POLAND
Prof. Bogusław Major – Cracow, POLAND
Prof. Thaddeus B. Massalski Dr hc – Pittsburgh, USA
Prof. Stanisław Mitura Dr hc – Łódź, POLAND
Prof. Henryk Morawiec – Katowice, POLAND

Prof. Stanisław Mrowec Dr hc – Cracow, POLAND
Prof. Jerzy Nowacki – Szczecin, POLAND
Prof. Ryszard Nowosielski – Gliwice, POLAND
Prof. Atsuchu Okazaki – Kyushu, JAPAN
Prof. Abraham Atta Ogwu – Paisley, UK
Prof. Lucjan Pająk – Katowice, POLAND
Prof. Roman Pampuch Dr hc – Cracow, POLAND
Prof. Fusheng Pan – Chongqing, CHINA
Prof. Jan Pilarczyk – Gliwice, POLAND
Prof. Richard Portier – Paris, FRANCE
Prof. Wojciech Przetakiewicz – Warsaw, POLAND
Prof. Maria H. Robert – Campinas, BRAZIL
Prof. Mario Rosso – Turin, ITALY
Prof. Jan Sieniawski – Rzeszów, POLAND
Prof. Paul Siffert – Strassburg, FRANCE
Prof. Jorge A. Sikora – Mar del Plata, ARGENTINA
Prof. Božo Smoljan – Rijeka, CROATIA
Prof. Jerry Sokolowski – Windsor, CANADA
Prof. Mirko Sokovic – Ljubljana, SLOVENIA
Prof. Antonio Sousa – Fredericton, CANADA
Prof. George A. Stergioudis – Thessaloniki, GREECE
Prof. Danuta Stróż – Katowice, POLAND
Prof. Dominique Schryvers – Antwerp, THE NETHERLANDS
Prof. Ludomir Ślusarski – Łódź, POLAND
Prof. Zbigniew Śmieszek – Gliwice, POLAND
Prof. Ming-Yen Tan – Singapore, SINGAPORE
Prof. Vasco Teixeira – Braga, PORTUGAL
Prof. Laszlo Toth – Miskolc, HUNGARY
Prof. Boris Tomov – Rousse, BULGARIA
Prof. Jose M. Torralba Dr hc – Madrid, SPAIN
Prof. Algirdas V. Valiulis – Vilnius, LITHUANIA
Prof. Tadeusz Wierzchoń – Warsaw, POLAND
Prof. Abdalla Wifi – Cairo, EGYPT
Prof. Władysław K. Włosiński Dr hc – Warsaw, POLAND
Prof. Stefan Wojciechowski Dr hc – Warsaw, POLAND
Prof. Gwomei Wu – Taoyuan, TAIWAN
Prof. Mieczysław Wysiecki – Szczecin, POLAND
Prof. Senay Yalcin – Istanbul, TURKEY
Prof. Bekir Sam Yilbas – Dhahran, SAUDI ARABIA
Prof. Andrzej Zieliński – Gdańsk, POLAND
Prof. Paweł Zięba – Cracow, POLAND
Prof. Jozef Zrník – Plzen, CZECH REPUBLIC
Prof. Marcel Žitnansky – Bratislava, SLOVAK REPUBLIC

Associate Editors

Dr Mirosław Bonek – Gliwice, POLAND
Dr Małgorzata Drak – Gliwice, POLAND
Dr Klaudiusz Gołombek – Gliwice, POLAND
Dr Daniel Pakuła – Gliwice, POLAND

Production Editor

Ms Marzena Kraszewska, MA – Gliwice, POLAND

Reading Direct Editors

Dr Zbigniew Brytan – Gliwice, POLAND
Dr Adam Polok – Gliwice, POLAND
Mr Piotr Zarychta, MSc – Gliwice, POLAND

Submission Officer

Dr Magdalena Polok-Rubiniec – Gliwice, POLAND

Computer typesetters

Ms Justyna Domagała, MSc – Gliwice, POLAND
Ms Barbara Dołęńska, MSc – Gliwice, POLAND
Ms Ludwina Żukowska, MSc – Gliwice, POLAND

Patronage

Polish Academy of Sciences
Division IV Technical Sciences
Committee of Materials Science

Abstracting services

This journal is sent to individual receivers from ca. 50 countries of the world and is delivered to the National Libraries and Universities and also to other scientific institutions in ca. 50 countries of the world. The electronic system of Reading Direct allows to access to the electronic version of that journal on-line, in the promotional period free of charge. This journal is included in the reference list of the Polish Ministry of Science and Higher Education (6 points). The procedure leading to the citation of that journal by Abstracting Services has already begun. The efforts to achieve the financing for the journal publication by the Ministry of Science and Higher Education in Poland has begun.

Publisher



International OCSCO World Press
ul. S. Konarskiego 18a/366
44-100 Gliwice, Poland
e-mail: info@archivesmse.org

Bank account:
Stowarzyszenie Komputerowej Nauki o Materiałach
i Inżynierii Powierzchni
Bank name: ING Bank Śląski
Bank address: ul. Zwycięstwa 28, 44-100 Gliwice, Poland
Account number/IBAN CODE:
PL76105012981000002300809767
Swift code: INGBPLPW

Gliwice
© 2007 International OCSCO World Press.
All rights reserved.

Reading Direct

This journal is a part of Reading Direct, the free of charge alerting service which sends tables of contents by e-mail for this journal and in the promotion period also the full texts of papers. You can register to Reading Direct at

<http://www.archivesmse.org>

© The paper used for this journal meets the requirements of acid-free paper.
Printed in Poland.

It was said...



José Manuel Durão Barroso
President of the European Commission

"(...) Action by the European Union and Member States has been responsible for major improvements in the field of environment protection - air and water quality, pollutants, protection of nature areas, and chemicals to name a few. And we have adopted the world's most ambitious strategy for combating climate change. (...) Europeans want 'more Europe'. It is easy to see why. Our citizens recognise that the environment and pollution know no borders. They understand that progress depends on international action. The European Union provides a unique, legally binding framework for this. The strength and effectiveness of cooperation between the EU and its Member States have made us global leaders in protecting the environment. (...) As Europe has grown, and grown together, we have learned an important lesson: that protecting our environment and our natural resources is not a luxury, but a crucial investment in our sustainable economic future. We know, for instance, that air and water pollution weaken our economies by making people sick. We know that over fishing today leaves fishing communities without work tomorrow. And we know that destroying ecosystems and species robs us of economically vital services. We cannot rest on our laurels, however. And Europe, let alone the rest of the world, still has a way to go. Protecting the environment for future generations continually raises new challenges. (...)"

The Opening Speech at Green Week in Brussels, Belgium,
12th June 2007

Editorial

As it can be read at the website the Polish Academy of Sciences is a state scientific institution founded in 1952. From the very beginning, it has functioned as a learned society acting through an elected corporation of top scholars and research organisations, via its numerous scientific establishments. After a long period of the constituting of the Authorities in 2006 the Presidium of the Academy taking responsibility for all strategic issues with the president, three vice-presidents, seven chairmen of the divisions, the presidents of the territorial branches, and additionally 14 additional members elected by the General Assembly from among the members of the Academy was founded. The Presidium supervises the research units and other establishments of the Academy. Professor Michał Kleiber M.dr hc, a Full Member of the Polish Academy of Sciences, was elected as the Academy's President for the 2007-2010 term. The president, who also chairs the General Assembly and the Presidium, is responsible for the Polish Academy of Sciences activities on an everyday basis. The Academy is composed of national members (including both full and corresponding members) and foreign members. The membership in the Academy is held for life. The number of national members is set at no more than 350. All members (national and foreign) are elected by the General Assembly from among candidates with the highest scientific achievements and of recognised authority. The names of potential national members are submitted by current national members, the councils of university faculties, and the scientific councils of research establishments in Poland (including the Academy institutes). Foreign members are proposed and elected by the national members. Each member of the Academy is a member of one of the seven divisions, according to her or his scientific discipline. Members are responsible for their own scientific activities as well as the statutory tasks of the Academy.

The organisational structure of the Academy is comprised of divisions, territorial branches and scientific and task force committees. There are seven territorial branches of the Academy: Gdańsk, Katowice, Kraków, Lublin, Łódź, Poznań and Wrocław. Their role is to integrate the local scientific communities and act as representatives of the Academy to the local authorities and organisations. The territorial branches consist of national Academy members, according to their place of residence. There are seven divisions of the Academy: Division I Social Sciences, Division II Biological Sciences, Division III Mathematical, Physical, and Chemical Sciences, Division IV Technical Sciences, Division V Agricultural, Forestry, and Veterinary Sciences, Division VI Medical Sciences, and Division VII Earth and Mining Sciences. Each Division formulates opinions on issues concerning its scientific disciplines and provides advice to the Academy authorities on research priorities and policy in a given field. It is also their task to supervise and coordinate the activities of the Division's scientific committees, as well as to generally supervise all Academy research establishments in a given field. Each Division is chaired by its elected chairperson. Professor Władysław Włosiński M.dr hc, a Corresponding Member of the Polish Academy of Sciences, was elected as the Division's IV Technical Sciences Chairman for the 2007-2010 term.

The committees are a very special part of the Polish Academy of Sciences. They fall into two groups: the scientific committees affiliated with the Divisions, and the task force committees (also called the problem committees) affiliated with the Presidium. The Academy's network of 109 committees constitutes a major representation of all researchers in Poland and of the Academy's advisory bodies. Scientific committees of the Polish Academy of Sciences constitute the independent, cooperating with the Academy's divisions, nation-wide representation of individual disciplines or their groups or interdisciplinary scientific problems, serving the integration of researchers from the whole country. The committees are composed of the members of the Polish Academy of Sciences of respective disciplines, outstanding research workers of higher education establishments, research centres of the Polish Academy of Sciences, departmental research units and of economic and social organisations. Their membership amounts to about 4,000 elected members. Each scientific committee constitutes a self-governing representation of a scientific discipline for the purpose of integrating Polish scholars. The tasks of the scientific committees are: to deal with the problems of a particular discipline, to contribute to the dissemination of the research results, and to initiate cooperation with foreign scientific centres. Scientific committees as bodies of the Academy affiliated with the divisions perform advisory and consultative functions. The basic task of committees is to influence the development of a given discipline on a country scale as well as to integrate research centres and communities and to solve certain research problems. Committees' activities in the field of consultation, dissemination and introduction of the results of scientific research, including in particular the organisation of scientific conferences and meetings and the initiation of scientific research are of particular significance. A number of committees produce their own publications (monographs and journals), in which the papers dealing with the disciplines covered by their scope of activities are published. One of those journals is Archives of Materials Science and Engineering.

Scientific Committees affiliated with the Division IV Technical Sciences of the Polish Academy of Sciences are as follows: the Committee on Acoustics, the Committee on Architecture and Urban Planning, the Committee on Automatic Control and Robotics, the Committee on Biocybernetics and Biomedical Engineering, the Committee on Chemical and Process Engineering, the Committee on Civil Engineering and Hydroengineering, the Committee on Electrical Engineering, the Committee on Electronics and Telecommunication, the Committee on Informatics, the Committee on Machine Building, the Committee on Materials Science, the Committee on Mechanics, the Committee on Metallurgy, the Committee on Metrology and Research Equipment, the Committee on Thermodynamics and Combustion, the Committee on Transport. The beginning of 2007 was a time of intensive activities in the society of the Polish Academy of Sciences. The election of all members of Scientific Committees affiliated with the Divisions of the Polish Academy of Sciences took place.



As a result of common election the following persons in the alphabetic order were chosen in the makeup of the Committee on Materials Science: Prof. Tadeusz Bold (Gliwice), Prof. Jan Chłopek (Kraków), Prof. Jan Cwajna (Katowice), Prof. Leszek A. Dobrzański M.dr hc (Gliwice), Prof. Jan Dutkiewicz (Kraków), Prof. Marek Hetmańczyk (Katowice), Prof. Leopold Jeziorski Dr hc (Częstochowa), Prof. Piotr Kula (Łódź), Prof. Tadeusz Kulik (Warszawa), Prof. Krzysztof Kurzydłowski (Warszawa), Prof. Jerzy Lis (Kraków), Prof. Bogusław Major (Kraków), Prof. Wojciech Przetakiewicz (Warszawa), Prof. Jan Sieniawski (Rzeszów), Prof. Tadeusz Wierchoń (Warszawa), Prof. Mieczysław Wysiecki (Szczecin). As a result of numerous state duties Prof. Krzysztof Kurzydłowski, the State Undersecretary in the Ministry of Science and Higher Education was forced to resign from the work in that Committee. In the makeup of the Committee also Members of the Polish Academy of Sciences Prof. Adam Gierek (Katowice), Prof. Maciej W. Grabski Dr hc (Warszawa), Prof. Adolf Maciejny Dr hc (Katowice), Prof. Roman Pampuch Dr hc (Kraków) and Prof. Władysław Włosiński M.Dr hc (Warszawa) were included.

On the first inaugural meeting on 2nd July 2007 in Katowice Professor Władysław Włosiński M.dr hc, the Division's IV Technical Sciences Chairman handed the act of the nominations in the makeup of the Committee. In connection with the finalisation of the cadence 2004-2006 he expressed also his thanks for the activeness of the members of the Committee in that cadence and especially the many-year-Chairman - Prof. Adolf Maciejny Dr hc. Also an additional election of the rest members of the Committee took place. The following persons in the alphabetical order were chosen: Prof. Krystyna Czaplicka-Kolarz (Katowice), Mr Marek Darecki, MSc (Rzeszów), Prof. Zbigniew J. Gronostajski (Wrocław), Prof. Mieczysław Jurczyk (Poznań), Prof. Jan Kusiński (Kraków), Prof. Eugeniusz Łągiewka (Katowice), Prof. Adam Mazurkiewicz (Radom), Prof. Stanisław Mitura Dr hc (Łódź), Prof. Jerzy Nowacki (Szczecin), Prof. Jerzy Szawłowski (Warszawa), Prof. Andrzej Zieliński (Gdańsk) and Prof. Paweł Zięba (Kraków). Also 2 Honorary Members of the Committee in the persons of Prof. Ludomir Ślusarski (Łódź) and Prof. Stefan Wojciechowski Dr hc (Warszawa) were chosen. The select Presidium of the Committee was constituted. Prof. Marek Hetmańczyk was chosen unanimously as a chairman. Prof. Tadeusz Kulik and Prof. Bogusław Major were chosen for vice chairmen. Prof. Jan Cwajna was chosen a secretary. In the makeup of the Presidium of the Committee also Prof. Leszek A. Dobrzański M.dr hc - the Editor-in-Chief of Archives of Materials Science and Engineering was included. It was decided that on the next meeting, already in the full makeup which is planned on the third decade of September 2007 in Warsaw, the specialist Sections of the Committee will be created and their Chairmen who will be included in the makeup of the Presidium of the Committee will be chosen. The specialist Sections of the Committee will be created and their Chairmen who will be included in the makeup of the Presidium of the Committee will be chosen.

All that is left for me is to wish the chosen members and the Presidium of the Committee the satisfaction of the activeness and good results in the activeness in aid of scientific society of materials science and engineering.

Prof. Leszek A. Dobrzański Dr hc
Editor-in-Chief of the AMSE
President of the ACMSS
Director of the IEMGB of the SUT

Gliwice, in July 2007

Thematic scope of papers

MATERIALS

Metallic Alloys, Tool Materials, Superplastic Materials, Ceramics and Glasses, Composites, Amorphous Materials, Nanomaterials, Biomaterials, Multifunctional Materials, Smart Materials, Engineering Polymers

PROPERTIES

Ductility, Crack Resistance, Fatigue, Creep-resistance, Fracture Mechanics, Mechanical Properties, Electrical Properties, and Magnetic Properties, Corrosion, Erosion, Wear Resistance, Non-Destructive Testing, Reliability Assessment, Toxicity, Working Properties of Materials and Products

METHODOLOGY OF RESEARCH, ANALYSIS AND MODELLING

Electron Microscopy, X-ray Phase Analysis, Metallography, Quantitative Metallography, Image Analysis, Computer Assistance in the Engineering Tasks and Scientific Research, Numerical Techniques, Statistic Methods, Residual Life Analysis, Process Systems Design, Mould Flow Analysis, Rapid Prototyping, CAM, CAMS, CAQ, Engineering Design, Technological Design, Materials Design, Computational Material Science, Materials and Engineering Databases, Expert Systems, Artificial Intelligence Methods

MATERIALS MANUFACTURING AND PROCESSING

Casting, Powder Metallurgy, Welding, Sintering, Heat Treatment, Thermo-Chemical Treatment, Thin & Thick Coatings, Surface Treatment, Machining, Plastic Forming, Quality Assessment, Automation Engineering Processes, Robotics, Mechatronics, Technological Devices and Equipment, Theoretical Fundamentals of Cleaner Production, Industrial Application of Cleaner Production Methods, Production and Operations Management, Production Planning and Control, Manufacturing Technology Management, Quality Management, Environmental Management, Safety and Health Management, Project Management, Physical Distribution and Logistics Management, Supply Chain Management, Productivity and Performance Management

EDUCATION AND RESEARCH TRENDS IN MATERIALS SCIENCE AND ENGINEERING

Development of New Curricula for BSc, MSc and PhD Studies, Challenges of the Widening Labour Market, Complementary Roles of Developed and Developing Nations in Promoting a Global Industrial and Economical Infrastructure and Requirements on Common International Research and Teaching Development, Computer Aided Teaching, E-learning

Only papers positively pre-reviewed by at least two reviewers are published in the journal.