# of Achievements in Materials and Manufacturing Engineering

Published monthly as the organ of the World Academy of Materials and Manufacturing Engineering

Editor-in-Chief Prof. Leszek A. Dobrzański

Volume 37 • Issue 2 • December 2009



http://www.journalamme.org



of Achievements in Materials and Manufacturing Engineering

PUBLISHED SINCE 1992 formerly as Proceedings on Achievements in Mechanical and Materials Engineering

# Published monthly as the organ of the World Academy of Materials and Manufacturing Engineering

# **Editor-in-Chief**

Prof. Leszek A. Dobrzański - Gliwice, Poland

#### **Deputies Editor-in-Chief**

#### South America

Prof. Maria Helena Robert - Campinas, Brazil North America Prof. George Totten - Portland, USA Europe Prof. Jose Manuel Torralba - Madrid, Spain Asia Prof. Yong Taek Im - Daejeon, South Korea Australia Prof. Kanaka Durga Vara Prasad Yarlagadda - Brisbane, Australia Africa Prof. Abdalla Wifi - Cairo, Egypt

#### Associate Editors

Dr Mirosław Bonek Dr Małgorzata Drak Dr Klaudiusz Gołombek Ms Marzena Kraszewska, MA Dr Janusz Madejski Dr Daniel Pakuła

# **Editorial Assistance**

Dr Magdalena Polok-Rubiniec Dr Anna Włodarczyk-Fligier Dr Bogusław Ziębowicz Mr Wojciech Borek, MSc Ms Justyna Hajduczek, MSc Mr Paweł Jarka, MSc

# **Reading Direct**

Dr Adam Polok Mr Piotr Zarychta, MSc



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.journalamme.org

# Editorial Board

Prof. Gilmar Batalha - Sao Paulo, Brazil Prof. Emin Bayraktar - St-Ouen, France Prof. Milan Brandt - Swinburne, Australia Prof. Tara Chandra - Wollongong, Australia Prof. Antonio Cuhna - Guimaraes, Portugal Prof. Marek Dollar - Oxford, Ohio, USA Prof. J. Paulo Davim - Aveiro, Portugal Prof. Sabahudin Ekinović - Zenica, Bosnia and Herzegovina Prof. Renato Esposito - Naples, Italy Prof. Spilios Fassois - Patras, Greece Prof. Swadhin Ghosh - Rösrath, Germany Prof. Janez Grum - Ljubljana, Slovenia Prof. Toshio Haga - Osaka, Japan Prof. Abdel Magid Hamouda - Doha, Qatar Prof. Stuart Hampshire - Limerick, Ireland Prof. Lauri Holappa - Espoo, Finland Prof. John Barry Hull - Nottingham, United Kingdom Prof. Mark James Jackson - West Lafayette, Indiana, USA Prof. Krzysztof Jemielniak - Warsaw, Poland Prof. Jerzy Jedrzejewski - Wrocław, Poland Prof. Yosef Katz - Beer Sheva, Israel Prof. Andrzej Klimpel - Gliwice, Poland Prof. Ivars Knets - Riga, Latvia Prof. Janez Kopac - Ljubljana, Slovenia Prof. Karl Kuzman - Ljubljana, Slovenia Prof. Anatolij Kuzmenko - Khmielnitsky, Ukraine Prof. Petr Louda - Liberec, Czech Republic Prof. Stanisław Mitura - Łódź, Poland Prof. Andrew Nee - Singapore, Singapore Prof. Jerzy Nowacki - Szczecin, Poland Prof. Abraham Ogwu - Paisley, United Kingdom Prof. Fusheng Pan - Chongqing, China Prof. Mario Rosso - Turin, Italy Prof. Antonio Sousa - Fredericton, NB, Canada Prof. Božo Smoljan - Rijeka, Croatia Prof. Jerry Sokolowski - Windsor, Ontario, Canada Prof. Zinovij Stotsko - Lviv, Ukraine Prof. Jerzy Świder - Gliwice, Poland Prof. Ming-Jen Tan - Singapore, Singapore Prof. Boris Tomov - Rousse, Bulgaria Prof. Marcel Van De Voorde - Brussels, Belgium Prof. Senay Yalcin - Istambul, Turkey Prof. Bekir Sam Yilbas - Dhahran, Saudi Arabia



# Patronage

World Academy of Materials and Manufacturing Engineering



Polish Academy of Sciences, Committee of Materials Science, Section of Metallic Materials

International Federation of Heat Treatment and Surface Engineering



Association of Computational Materials Science and Surface Engineering



Institute of Engineering Materials and Biomaterials of Silesian University of Technology, Gliwice, Poland

## **Financial support**

In 2009 the publication of the Journal is financially supported by the Ministry of Science and Higher Education in Poland.

#### 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 Journal is cited by Abstracting Services such as:



The procedure of its registration in the databases of Scopus, Compandex, CiteSeer, GetCited and Web of science has begun.

# **Journal Registration**

The Journal is registered by the Civil Department of the District Court in Gliwice, Poland at number 279.

#### Publisher

WORLD PRESS

Gliwice 44-100, Poland ul. S. Konarskiego 18a/366 e-mail: info@journalamme.org

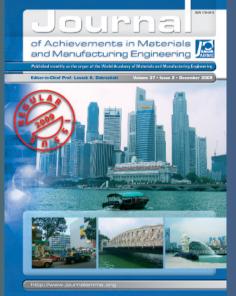
Bank account: Stowarzyszenie Komputerowej Nauki o Materiałach i Inżynierii Powierzchni Bank name: ING Bank Śląski

Bank address: ul. Zwycięstwa 28, 44-100 Gliwice, Poland Account number/ IBAN CODE: PL76105012981000002300809767 Swift code: INGBPLPW

Gliwice – Campinas – Portland – Madrid – Daejeon – Brisbane – Cairo \* 2009 International OCSCO World Press. All rights reserved

The paper used for this Journal meets the requirements of acid-free paper Printed in Poland

Encouraged by the overwhelming suc-ICMAT conferences, the Materials Research Society of Singapore hosted the 5<sup>th</sup> Interna-tional Conference Advanced Technologies ICMAT 2009 from 28 June to 3 July 2009 at the Suntec Singapore Convention and Exhibition Centre. These conferences were attended by more than 2,000 members of the international scientific and materials research countries. There were 23 Symposia



Cover story

covering contemporary topics of importance for the science, engineering and technology of materials. The technical programme included Plenary, Keynote, Invited, Oral and Poster presentations. About 50 international exhibitors from all sectors of materials science and engineering communities also showcased their products and equipment during the conference. In line with the previous ICMAT conferences, a few Nobel Laureates spoke at the conference. They also gave public lectures at the University Cultural Centre of the National University of Singapore. These lectures were opened to conference participants and to the general public including students from local Junior Colleges, Polytechnics and Universities ICMAT 2009 was a multidisciplinary forum providing over 2,000 research scientists and engineers a first-hand learning platform, as well as the opportunity to share and exchange ideas with some of the best minds in the field. The ICMAT 2009 was organised by Materials Research Society in Singapore in association with the National University of Singapore, the Institute of Materials Research and Engineering and the Nanyang Technological University.

Singapore, officially the Republic of Singapore, is an island city-state off the southern tip of the Malay Peninsula, 137 kilometres north of the equator, south of the Malaysian state of Johor and north of Indonesia's Riau Islands. At 710.2 km² Singapore is a microstate and the smallest nation in Southeast Asia. Singapore is a parliamentary republic, and the Constitution of Singapore establishes representative democracy as the nation's political system. The population of Singapore including non-residents is approximately 4.99 million. Singapore is highly cosmopolitan and diverse with Chinese people forming an ethnic majority with large populations of Malay, Indian and other people. English, Malay, Tamil, and Chinese are the official languages. A modern economy of Singapore is the 5<sup>th</sup> wealthiest country in the world in terms of GDP per capita. The 2009 Cost of Living survey, by consultancy firm Mercer, has ranked Singapore as the tenth most expensive city for expatriates to live in. In 2009, the Economist Intelligence Unit ranked Singapore similarly the tenth most expensive city in the world in which to live – the third in Asia, after Tokyo and Osaka.

On the cover you can see some views from the City Singapore.