ISSN 1734-8412

# Journa

## of Achievements in Materials and Manufacturing Engineering



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

Volume 36 • Issue 1 • September 2009 Editor-in-Chief Prof. Leszek A. Dobrzański



### Journa

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 Marta Górniak, MSc

Ms Justyna Hajduczek, MSc

Mr Paweł Jarka, MSc

Mr Grzegorz Krawczyk, MSc

Ms Ludwina Żukowska, Msc



#### Reading Direct

Dr Adam Polok

Mr Piotr Zarychta, MSc



#### 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.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:







Ulrich's Periodical Directory

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**



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

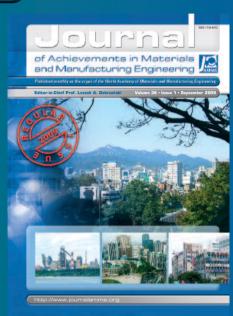
Bank account:

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

 ${\sf Gliwice-Campinas-Portland-Madrid-Daejeon-Brisbane-Cairo}$ 

 2009 International OCSCO World Press. All rights reserved
The paper used for this Journal meets the requirements of acid-free paper Printed in Poland Cover story



The popular name of South Korea, officially the Republic of Korea and often referred to as Korea is "Land of the Morning Calm". It is a country in East Asia. South Korea is occupied in the southern half of the Korean Peninsula. The main picture in the cover presents the general view of Seoul. Seoul, one of the largest metropolitan city in the world is the capital of South Korea. Seoul, is consistently placed among the world's top ten financial and commercial cities. The city is located on the basin of the Han River in the country's north-west. The central small picture presents the bird's eye view of an old building of the city major. The next small picture presents the general view of the Pohang Iron and Steel Company, or POSCO in Pohang, as the world's second largest steel producer, and a host of related industries. Pohang is a city in North Gyeongsang Province, South Korea. The last one presents the night view of Daejeon, the capital city of Chungcheongnamdo Province, located in the centre of South Korea. In this city in Daedeok Science Town the KAIST (formerly known as Korea Advanced Institute of Science and Technology), a research University, is located. It is the nation's leading science and technology institution and is considered to be the MIT of South Korea.