

Preface

Processing of metals and their alloys into final products that meet customers' expectations in terms of shape, dimensions and final properties requires various operations, most often connected with the metal forming. It has always been, and continuously is, an important manufacturing process used for many applications starting from nanoparts of electronic systems, through bioengineering applications, automotive and aerospace industry, to massive components used in offshore or nuclear applications. Continuous development in metal forming technologies e.g. hot stamping brings about possibilities to obtain new, yet better products with complex shapes and enhanced properties, tailored to specific often more and more demanding applications. Therefore, metal forming attracts the interest of scientists, academics and researchers all around the world. This provides a great motivation for organising the conference as a forum for discussion and dissemination of recent developments, innovations and advances in this field of science and technology.

This volume of Key Engineering Materials contains papers presented at the 16th Metal Forming International Conference held in Kraków, Poland on September 18-21, 2016. Metal Forming 2016 is the 16th in a series of International Conferences organized by AGH University of Science and Technology since 1974. From 1994 to 2010 the Conference was organized biannually, jointly with the University of Birmingham, UK. The latter was replaced by the University of Toyohashi in 2010, when the Conference went, for the first time, to Japan. Metal Forming 2012 was organized in Kraków by AGH University of Science and Technology, together with the University of Toyohashi and, for the first time, by the University of Palermo, Italy, which had joined the Organization team, and hosted the Conference in 2014.

The papers published in this volume represent the state-of-the-art in the field of metal forming science and technology. The contents of more than 120 contributions submitted by authors representing universities, research institutes and industry from all over the world demonstrate the results of a very wide spectrum of research topics, from micro- and nano- forming, to the numerical modelling of processes and systems. The applications of the latest achievements in material characterisation techniques for prediction of microstructure evolution and mechanical properties during or after thermomechanical processing are also presented. Constitutive and numerical modelling as well as optimisation of processes and systems is the topic of a significant part of contributions. Manuscripts cover a wide range of materials from metal powders, titanium and magnesium alloys to advanced high strength steels and multiphase materials.

We would like to express our gratitude to the reviewers of the submitted papers, principally to the Members of the Scientific and Steering Committees of the Conference, for their hard work and critical, but constructive remarks, which were helpful in maintaining the high scientific level of the Conference. We hope that the proceedings will become a source of valuable information and inspiration in the scientific work for academics, researchers, engineers and students, and we are pleased to welcome in Kraków every Participant of the 16th Metal Forming Conference.

Danuta Szeliga and Krzysztof Muszka
AGH University of Science and Technology, Kraków, Poland

Committees

Steering Committee

Maciej Pietrzyk
Jan Kusiak
Janusz Majta
Peter Hartley
Jianguo Lin

AGH University of Science and Technology, Kraków, Poland
AGH University of Science and Technology, Kraków, Poland
AGH University of Science and Technology, Kraków, Poland
University of Birmingham, UK
Imperial College London, UK

Scientific Committee

Yohei Abe
Julian M. Allwood
Denis Jorge Badiola
Dorel Banabic
Thierry Barriere
Bernd-Arno Behrens
Piotr Breitkopf
Stefania Brusci
Bruno Buchmayr
Jian Cao
Ellen K. Ceretta
Elisabetta Ceretti
Jose Cesar de Sa
Didier Claude Farrugia
Luigino Filice
Lander Galdos
Zbigniew Gronostajski
Isabel Gutierrez
Anne Marie Habraken
Kunio Hayakawa
Gerhard Hirt
Peter Damian Hodgson
Martin Jackson
Rudolf Kawalla
Kazuhiko Kitamura
Andrzej Kocańda
Michał Krzyżanowski
Takashi Kuboki
Jari Larkiola
Hui Long
Janusz Łuksza
Tomoyoshi Maeno

Toyohashi University of Technology, Japan
University of Cambridge, UK
CEIT, Spain
Technical University of Cluj-Napoca, Romania
ENSMM, Besançon, France
Leibniz Universität Hannover, Germany
Université de Technologie de Compiègne, France
University of Padova, Italy
University of Leoben, Austria
Northwestern University, USA
Los Alamos National Laboratory, USA
Brescia University, USA
University of Porto, Portugal
Tata Steel Ltd, UK
University of Calabria, Italy
Mondragon University, Spain
Wrocław University of Technology, Poland
Centre for Technical Research and Studies, Spain
University of Liege, Belgium
Shizuoka University, Japan
RWTH Aachen, Germany
Deakin University, Australia
The University of Sheffield, UK
TU Bergakademie Freiberg, Germany
Nagoya Institute of Technology, Japan
Warsaw University of Technology, Poland
AGH University of Science and Technology, Poland
University of Electro-Communications, Japan
University of Oulu, Finland
The University of Sheffield, UK
AGH University of Science and Technology, Poland
Yokohama National University, Japan

| | |
|----------------------------|---|
| Ken-ichi Manabe | Tokyo Metropolitan University, Japan |
| Ryo Matsumoto | Osaka University, Japan |
| Kiyotaka Matsuura | Hokkaido University, Japan |
| Marion Merklein | University of Erlangen-Nuremberg, Germany |
| Wojciech Zbigniew Misiólek | Lehigh University, USA |
| Pierre Montmittonet | Cemef - MINES ParisTech, France |
| Sebastian Mróz | Częstochowa University of Technology, Poland |
| Masaaki Otsu | University of Fukui, Japan |
| Zbigniew Pater | Lublin University of Technology, Poland |
| Henryk Paul | Institute of Metallurgy and Materials Science PAN |
| Elena Pereloma | University of Wollongong, Australia |
| Pavel Petrov | Bauman Moscow State Technical University, Russia |
| Ivo Schindler | Technical University of Ostrava, Czech Republic |
| Siegfried Schmauder | University of Stuttgart, Germany |
| Christof Sommitsch | Graz University of Technology, Austria |
| A. Erman Tekkaya | Technical University of Dortmund, Germany |
| Hiroshi Utsunomiya | Osaka University, Japan |
| A.H. Ton van Den Boogaard | University of Twente, The Netherlands |
| Bradley Wynne | The University of Sheffield, UK |
| Ming Yang | Tokyo Metropolitan University, Japan |

Conference Chairs

| | |
|------------------|--|
| Danuta Szeliga | AGH University of Science and Technology, Kraków, Poland |
| Krzysztof Muszka | AGH University of Science and Technology, Kraków, Poland |
| Livan Fratini | University of Palermo, Italy |
| Fabrizio Micari | University of Palermo, Italy |
| Ken-ichiro Mori | Toyohashi University of Technology, Japan |

Local Organizing Committee

| | |
|------------------|--|
| Danuta Szeliga | AGH University of Science and Technology, Kraków, Poland |
| Krzysztof Muszka | AGH University of Science and Technology, Kraków, Poland |

AGH University of Science and Technology, Kraków,
Poland



University of Palermo, Italy



Toyohashi University of Technology, Japan

