Introduction

Faculty of Materials Engineering and Metallurgy is one of the 13 Faculties at Silesian University of Technology. Located at Katowice faculty employs 30 professors and associate professors as well as 63 doctors. Scope of research activities includes materials engineering and metallurgy. Many research works carried out at the faculty concern problems related to the development of technologies and shaping the structure and properties of lightweight construction materials.

This is issue is the third collection of papers presenting the results of research in scope of light metal alloys. That issue include three chapters: I – aluminium alloys, II – magnesium alloys and III – titanium alloys.

Chapter I presents the subjects relating to the manufacturing of aluminum alloys, grain refinement and welding joints. This chapter presents also result of investigations concerning methods of obtaining and properties of aluminium matrix composites.

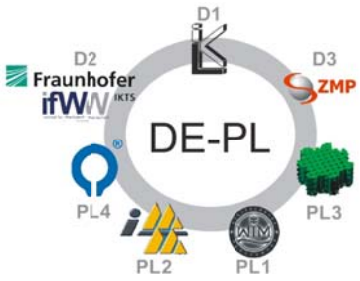
Chapter II contain the papers presenting the results of researches carried out on conventional and new casting magnesium alloys. The first group of articles concern the effects of modification on the structure and properties of casting alloys. Following papers present results of researches on plastic deformation of Mg alloys. Subsequent articles cover topics related to the welding technologies. Last part of the chapter concern the magnesium matrix composites.

Results of researches carried out on titanium alloys are presented in Chapter III.

Papers included in this section concern the microstructure and properties Ti alloys. Possibilities of heat treatment and diffusion brazing are discussed, too.

This project is the series of volume in the area of light metal alloys. The authors are planning to continue the series and publish as annual “Metallurgist Day” conference proceedings.

Editors.



Bi-national Research Project "3D-textile reinforced Al-matrix composites (3D-CF/Al-MMC) for complex loading situation in automobile applications and mechanical engineering"

The bi-national Research Project "3D-textile reinforced Al-matrix composites (3D-CF/Al-MMC) for complex loading situation in automobile applications and mechanical engineering" was funded by German Research Foundation (DFG) in Germany as PAK 258 and by Ministry of Science and Higher Education in Poland as project no. 106/N-DFG/2008/0 and 769/N-DFG/2010/0 in the first and second stage, respectively. It has been initiated in 2008 by Prof. Dr.-Ing. habil. Prof. e.h. Dr. h.c. Werner Hufenbach from Technische Universität Dresden and Prof. dr. hab. Krzysztof J. Kurzydlowski, dr. h.c. from Warsaw University of Technology.

Goal of the bi-national joint project was the elaboration of the materials engineering, mechanical and technological basis for the load-adapted robust and efficient manufacturing of 3D-textile reinforced carbon fibre/aluminium matrix composite structures. In this project 3 partners from Germany and 4 from Poland, from leading research institutions were involved.

To cover the whole development chain within the project following participants were involved:

- D1 – Institute of Lightweight Engineering and Polymer Technology (ILK) Technische Universität Dresden (*W. Hufenbach, M. Gude – project coordinators A. Czulak, P. Malczyk)*
- D2 – Fraunhofer Institute for Ceramic Technologies and Systems (FhG IKTS), Dresden (*I. Endler – leader, A. Zainal Abidin, M. Höhn, M. Krug),*
- D3 – Central Institute for New Materials and Processing Technology (ZMP) University Erlangen-Nuremberg *(R. F. Singer – leader, F.S. Kachold, J. Köpf, H. Ballmes),*
- PL1 – Faculty of Materials Science and Engineering (ZPM), Warsaw University of Technology (*K.J. Kurzydlowski, A.Boczkowska – project coordinators, R. Kozera, A. Sałacinska, J. Bielinski),*
- PL2 – Faculty of Materials Engineering and Metallurgy (ZKiMP), Silesian University of Technology, Gliwice (*J. Sleziona, M. Dyzia – leaders, A.J. Dolata),*
- PL3 – Institute of Materials Science and Applied Mechanics (IMiMT), Wroclaw University of Technology *(J. Kaleta - leader, G. Zietek, T. Czaplinski, Ł. Maciejewski)*,
- PL4 – Foundry Research Institute (IOD), Cracow *(N. Sobczak - leader, A. Kudyba, A. Siewiorek, M. Homa, J. Sobczak, G. Bruzda, B. Korpala, A. Tchórz)*.

The intention was to utilize the complementary knowledge and competencies of German (D) and Polish (PL) research facilities in the field such as: electroless coating technologies and interface phenomena like wetting (PL), light-metal matrix systems (PL), composite microstructure and micro scale modelling (PL), material characterization (D), process technologies (D) as well as meso and macro-scale modelling (D). In the second project phase, coating technologies based on the chemical vapour deposition process (CVD) were contributed by the new partner Fraunhofer Institute for Ceramic Technologies and Systems (FhG IKTS, D) in order to further extend the coating spectrum within the joint project and to individually adapt the preform coating to the gas pressure infiltration and the die casting process requirements, respectively.

The main focus of the Polish workgroups was directed towards elucidating the microstructure locally, for which theoretical and experimental methods in terms of micro modeling, coating and alloy composition on the micro/meso level were elaborated and applied. In contrast, the research activities of the German partners was mainly focused on a modeling approach on the meso/macro level and the development of manufacturing technologies suitable for serial production. Thus, the German-Polish collaboration follows a cross-scale approach with intensive interactions and with the goal to research light-metal structures and technologies in order to provide a theoretical and technological basis for the exploitation of the high lightweight potential and the utilisation of the broad design possibilities to fully exploit the existing lightweight potential for composite structures stressed in a complex manner.

In order to fully exploit the high lightweight potential and the broad design possibilities of 3D-CF/Al-MMC following challenges were undertaken:

- tailoring of the interface properties by structural modification of fibre/matrix interface using coatings, such as Ni-P, Ni-P with nanoparticles, TiN, SiC and Al_2O_3 to suppress Al-carbide formation of HT-carbon fibre in MMC,
- establishment of methods to remove sizing from carbon-fibre preforms without fibre degradation,
- modification of aluminium alloys for gas pressure infiltration (GPI) and high pressure die cast (HPDC) infiltration of HT-carbon fibre preforms,
- improvement of fibre wettability and adhesion by nanoscale optimization of fibre surface,
- development of suitable coatings for 3D-CF/Al-MMC to ensure oxidation resistance,
- development of efficient and robust manufacturing methods and processes,
- 3D-textile preform design with respect to process conditions as well as to loading conditions,
- stabilization, attachment and pre-heating of textile preforms for GPI and HPDC processes,
- design of multi-functional pressure die cast moulds by process simulation and thermo-mechanical analyses,
- optimization of process parameters (e.g. temperature versus time) for CF/Al-MMC manufacture with regard to small and large batch production,
- development of multi scale (micro-, meso-, macro-mechanical) material models and failure models for multiaxial reinforced CF/Al-MMC.

For the successful research of a highly interdisciplinary nature, collaboration of research teams from materials science, lightweight engineering, metallurgy, processing technology as well as from material and applied mechanics was necessary. The project was finished in March 2013 and the most imported results can be found in the book edited by M. Gude and A. Boczkowska “Textile reinforced carbon fibre/aluminium matrix composites for lightweight applications” printed in Foundry Research Institute Publishing House under the auspices of the World Foundry Organization, Commission 8.1 CAST COMPOSITES.