Editorial

The most important information of the last weeks for P.T. Authors and P.T. Readers of the Journal of Achievements in Materials and Manufacturing Engineering and two other journals published by the International OCSCO World Press, such as Archives of Materials Science and Engineering and Archives of Computational Materials Science and Surface Engineering is the one that all our papers were included to the list of journals indexed by the Directory of Open Access Journals. The result of the thorough analysis made by the referring subject is the confirmation of the high level and broad scope of influence of our journals. We are happy because of that great success and sure that it is important not only for us who edit and publish those journals but mainly for P.T. Authors and P.T. Readers of our journals.

Many new and contemporary science branches and disciplines, especially at the interdisciplinary areas of the traditional ones, have emerged since a positivist – Auguste Comte had categorised them. As a consequence of the development of physical metallurgy and many other fields of science and technology connected with a various group of materials useful in practice, materials science was created in the 1950s as the fundamental branch of science and also materials engineering as the engineering knowledge applied in the industrial practice. It is worth noting that just rendering accessible newer and newer technical materials, and with time also engineering ones within the compass of history, decided – as a rule – the significant, and quantum leap at times technical progress, determining improvement of the quality of life not unlike it is today. Therefore progress in the field of the advanced engineering materials is predicted and expected, including, among others, nanomaterials (with the particularly fine structure, ensuring the unexpected so far mechanical, as well as physical and chemical properties), biomaterials (as a group of the biomimetic materials and/or making it possible to substitute the natural human tissues and/or organs directly or designed into the purpose built devices), and infomaterials (as the most advanced group of smart- and self-organising materials), and also (functional or tool ones) gradient materials (in which properties change continuously or discretely with location because of the chemical composition, phase composition, and structure, or atomic orientation changing with the location), and light metals alloys (as materials of the particular importance, apart from the composite materials, in design and operation of the contemporary transport means), which issues decide development of materials engineering as one of the few areas of science and technology development most important nowadays in the contemporary World. It features also one of the most essential elements of the scientific-, scientific and technical-, and innovative policy within the framework of the knowledge based economy, consisting in knowledge generation, treated as production, and in distribution and practical use of knowledge and information. Therefore, production, distribution, and application of knowledge are the base of the economic development, and knowledge being a product features the main contribution to the sustainable development. The 7. European Union Framework Programme for years 2007-2013 (7. FP) in the area of research, technological development and implementations is among the main European Union main programmes and initiatives carried out within the international co-operation framework to achieve the above mentioned state. The scope of the CAPACITIES 7. FP detailed programme is of the vital importance for competitiveness and maintaining the productive potential of the European Union, for the inevitable strengthening of the industrial research, and the introduction of new solutions for improvement of the existing production potential. The IDEAS 7. FP detailed programme assumes supporting the most creative, interdisciplinary scientific frontier research. The new technologies development drivers, specified by the European Commission, include pressure on the development of new technologies, intensification of demand for new materials and manufacturing processes, and following the sustainable development principles. The innovation effects and connected with them competitiveness of products manufacturers on the international markets are clearly dependant on integration of various advanced branches of science and technology and on attaining the synergetic effects in development of new technologies, including material ones and pertaining to forming of structure and surface properties of engineering materials. The merits of research defined in 7. FP pertaining to the main materials engineering and manufacturing methods development line are comprised in the "Nanosciences, nanotechnologies, materials, and new manufacturing technologies" topic of the COOPERATION 7. FP detailed programme and suit well to the European policy of building the competitive Europe. Implementations of the emerging technologies have been included to the main tasks in this area, because of the anticipated possibilities of development of the new engineering materials for the expected applications, and also of the simplification of the engineering materials processing and alternative possibilities of manufacturing processes development in relation to the new engineering materials by specialisation (improvement of the existing materials technologies by attaining one of their main functions), convergence (attaining complex service properties by combining different engineering materials types), and integration (fabrication of the multifunctional materials using knowledge from many branches of science and technology to meet requirements of materials users and manufacturers).

What used to be typical of materials science for many years, and is typical even nowadays, has been employing the phenomenological models in many cases for description of phenomena and transformations occurring in technical materials, especially in the engineering ones, that is those manufactured in the purpose designed technological processes from raw materials available in the nature, in technological processes of manufacturing, processing, as well as forming of their structure and properties, for satisfying more and more complex practical requirements formulated by participants of the design process of products indispensable to the contemporary humans, including – among others – machines and devices. Materials have to be manufactured on demand today, meeting the complex set of the specific demands. Manufacturing is expected of materials with properties ordered by products users. This changes substantially the materials design methodology in general and the products materials design, as materials have to be delivered on demand of products manufacturers with the appropriately formed structure, ensuring the required set of physical and chemical properties, and not as before when the manufacturers were forced to select material closest to their expectations from the delivered materials with the offered structure and properties, yet – by assumption – not meeting them fully, which is not permitted by this design methodology. Therefore, the actual trends force classification of engineering materials based on their functional characteristics. Therefore, the type, and the chemical composition in particular, of the materials used are of less importance (to which materials engineers were used for decades, and especially the metallurgists), while its functionality is more important. Currently, materials engineers participate (and have to do so) in the products design processes and materials manufacturers have to face the requirements, as the effect of the multicriteria optimisation of, e.g., structure, properties, mass, product manufacturing and service costs, as well as of their ecological compatibility with the natural environment. Therefore, a change in the engineering materials role assessment is important, as they cannot be perceived any more as goods in themselves, with their applications sought for, and the market of the new engineering materials cannot remain the manufacturer's market any more. There is no way to offer materials which, by chance, are offered their manufacturers, regardless of the users' needs. The market of materials manufacturers is never to return. This is so since the new engineering materials and manufacturing processes are subordinated to customer needs and functional requirements of products. Manufacturing materials on demand fulfilling needs of market products manufacturers at the right time and place features a priority for new materials technologies and manufacturing processes, as the complementary base technologies (improvement of the existing solutions), alternative ones (taking advantage of synergy of various solutions), and original ones (new solutions being developed).

Many materials design methodology activities changed in this way, are connected with modelling, simulation and prediction of both the technological processes of manufacturing, processing, and forming their structure and properties, and especially of the service and use properties of materials, including those after long time service in the complex conditions, development of safe materials and products technologies, standardisation of materials testing procedures, development of the prediction methodology of the new materials behaviour in service. One should note that many classic calculation models developed to date, employed in materials science, e.g., Avrami equation used for processes being a function of time and temperature, Fick's laws for diffusion processes, Hall-Petch equation describing dependence of mechanical properties and grain size, Huber-von Mises yield criterion for determining the material loading condition in the complex strain state, equations of the classic mechanics of solids, equations of classic fracture mechanics, models developed using FEM and BEM as well as the related numerical methods, parametric equations and empirical equations, and others, do not fulfil the refined expectations of the designers, especially related to materials – in case of many contemporary material groups or structural phenomena occurring in them, because of the insufficient adequacy of models, and also often because of superposition or superimposition of processes – oftentimes opposing processes, and also due to difficulties in the simultaneous modelling of phenomena occurring at the same time in various scales – from nanometric to metric inclusive, lack of generality of the statistic and parametric equations because of the limited function domain (range) encompassing selectively only some material grades or types, so these factors decide the limited usability or simply impossibility to use those models to fulfil all expectations. Moreover, the trial-and-error method is often the ground of the classically used modelling methods and practical verification of the calculation results obtained is needed nearly each time, because of the significantly excessive mass of the employed materials (and, therefore, also of the products), and the need to employ the high values of the safety factors in product design, because of the insufficient dependability of the models used. Absence of the relevant analytical models is frequently the reason for stopping the progress of the products materials and technological design processes. This stops also the R&D projects in many materials engineering areas, forcing the classis trial-and-error method approach with the extensive experimental investigations plan, even if those experiments are statistically planned. All this causes also the unjustified increase of costs of such investigations and essential extension of the lead time needed to solve the scientific problem of the significant importance for the implementation practice. "As much science as there is mathematics". This is the traditional formula which acquires a quite new meaning today. Perhaps it should be – "as much science as there is computer science"?, or perhaps just – "as much science as there is prediction"! There is a general requirement for the reliable and adequate models both for materials properties prediction for fabrication of the expected products from them, and for materials life prediction, and also products made from them, after the duly planned and expected service life. Only this approach ensures effectiveness of the materials and technological design of products. Traditional calculation models cannot meet such requirements oftentimes. Therefore, the so called "Computational materials science" and "Computational surface engineering" are being developed intensely as the vanguard branches of the contemporary materials science and materials engineering. On one hand the mathematical statistics models are used, but mostly the artificial intelligence models, including, among others, neural networks, genetic algorithms, expert systems and fuzzy logic, fractal analysis, and also the multiscale modelling beginning from the contemporary physics models in the nanometric scale up to the numerical methods in the mezoscale, and the Virtual Reality tools. However, development and implementation of such models calls for setting up extensive databases and knowledge bases in advance, which require wide-ranging and methodically planned classical materials science investigations.

The presented modern approach to the solution of issues of materials engineering and surface engineering requires suitable education of engineering staff. It became basis of the application for financing of totally new in the European scale branches of studies realised at present by the Institute of Engineering Materials and Biomaterials of the Silesian University of Technology: "Applied computer science and computational materials science", "Nanotechnology and materials processing technologies" and "Materials engineering" profiled to dental engineering and industrial management. This education is totally financed in the framework of INFONANO project in the framework of the Operational Programme Human Capital financed in Poland in the framework of the European Social Fund. The development of the scientific staff in the field of "Computational materials science" and "Computational surface engineering" is foreseen in the framework of the application for financing in Poland the next project DEMCOMAS in the framework of the Operational Programme Innovative Economy. The equipment support for those activities was ensured in the framework of the project BIOFARMA in the framework of the Operational Programme Innovative Economy, MERMFLEG in the framework of Regional Operational Programme of the Silesian Region and LANAMATE qualified after the positive content-related evaluation to the second stage of the contest in the framework of the Operational Programme Infrastructure and Environment. The described activities allow for the positive evaluation of the perspectives of the evaluation of modern specialists of materials engineering in Poland.

Handing to P.T. Readers the next volume of our journal we encourage P.T. Authors for the publication of their next achievements and also to the promotion of their own participation in the programmes financed from the European Union resources.

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