Editorial

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Biographical notes: Janez Grum is the Founder and Editor-in-Chief of a new journal *Int. Journal of Microstructure and Materials Properties – IJMMP* and Editor of the *Journal News of Society for Nondestructive Testing*, Slovenian Society for Non-Destructive Testing, Ljubljana, Slovenia (since 1994). He is the Editor of the *Sixth NDT Conf. Proceedings*, two ASM and Marcel Dekker book Chapters, and five books with several reprints. He has also published more than 90 refereed journals and more than 300 conference papers on heat treatment, laser materials processing, materials testing including non-destructive testing.

The papers collected in the present issue of the journal were presented at a three-days International Conference organised jointly by the Croatian Society for Heat Treatment and Surface Engineering (CSHTE), the Austrian Society for Metallurgy and Materials (ASMET), and the Slovenian Society for Heat Treatment (SSHT) and sponsored by the International Federation for Heat Treatment and Surface Engineering (IFHTSE). The Conference was the first joint conference of the three associations from the neighbouring countries and was focused on the topics of heat treatment and surface engineering of tools and dies. The Conference was held from 8 to 12 June 2005 in Pulj, a city at the coast of the Northern Adriatic, which provided exceptional working environment for the participants. The President of the Conference was Professor Dr. B. Smoljan, President of the Croatian Society for Heat Treatment and Surface Engineering. He was assisted by Dr. H. Jäger, President of the ASMET, and Dr. V. Leskošek, President of the SSHT.

The themes of the Conference were exceptionally up to the minute since numerous papers of researchers from academic circles and industry were presented. The Conference participants had an excellent opportunity to discuss the papers in the presence of developers and researchers of materials and those of different production processes on the one hand and industrial manufacturers and users of the findings on the other hand.

The papers ranged from scientific findings to various technological solutions in the field of heat treatment and various processes for the modification of tool surfaces. Here belonged also the papers on modelling and simulation of various heat-treatment processes, which enabled experts to have a closer look to the conditions in a tool in the course of its manufacturing and during its operation.

At the Conference 76 papers, i.e., 44 lectures including four key-note papers and 32 posters were presented. The first group of papers treated hardening of various types of tool steels in terms of temperature-time conditions of austenitising and different quenching conditions, mechanical properties of steels, kinetics of transformations, and a study of the mechanism of bainitic transformation, and application of the modified Jominy test to the prediction of through-hardenability of cold-working tool steels.

The second group of the papers treated thermo-chemical surface treatment processes, which make it possible to obtain higher surface hardness and, consequently, increased wear resistance. Frequently other properties such as corrosion resistance and material fatigue resistance may be improved as well. The increased wear resistance can be attributed to a lower friction coefficient of the thermo-chemical surface treatment whereas the improved fatigue resistance is related to changes of hardness and residual stresses in the thin surface layer.

The third group of the papers treated the deposition of hard claddings on cutting tools and other tools for product forming. Hard claddings are comparatively thin; therefore, not only correct deposition of hard claddings on the tool surface but also the subsurface, which carries the total load, shall be taken care of. In the recent decades the development in the field of Chemical Vapour Deposition (CVD), where the process takes place on the hot surface of a workpiece specimen, and Plasma-Assisted Chemical Vapour Deposition (PACVD), where chemical reactions take place at much lower temperatures, has been intense. Another known procedure is depositing of Ti-, Cr- and Al-based nitride and carbo-nitride claddings. Here belong also aluminium-oxide claddings. Simultaneous developments of high-current and high-voltage power supplies, vacuum devices, options of process control and advances in plasma physics and chemistry made it possible to produce highly perfected systems for the production of PVD claddings. Recent advancements in the production of PVD claddings ensure high-quality claddings and high reliability of such claddings in operation under various tribological conditions.

Tool steels are most often alloyed steels, the alloying elements providing such a microstructure after heat treatment that very intricate properties may be obtained. They are a result of the choice of steel, tool forming and the entire process of manufacture, i.e., treatment. Consequently, the life of a tool is affected by the steel chosen, tool design, and mechanical treatment as well as heat treatment of vital tool parts. A tool life will be long only provided that the right steel for the tool has been chosen, the tool design is excellent, and tool manufacture, including heat treatment, is at its best. If any of these factors fails, the life may be shortened by a half, and with two deficient factors, the life may amount to only 20%.

The tool design is conditioned by the product to be made; therefore, experts shall fully collaborate in the choice of material and manufacturing processes, including thermo-chemical and heat treatment processes. Basic issues encountered by experts in practice is how to accomplish synergic effects of mechanical properties and operating conditions in product design so that wear, material fatigue and cracking at the tool surface, which may produce a major damage to a tool during its short life, may be avoided.

Rosso focuses on the fundamental effects produced by heat treatments on tool steels, with particular emphasis on alloying elements, as well as process parameters. He studied two different grades of high-speed steels with influence of the treated temperature on microstructural and mechanical properties. Kaleicheva studied special features of the kinetics and mechanism of the bainitic transformation in high-speed steel HS 18-0-1. The effects of heating temperature and that of austempering temperature have been investigating on the phase composition, microstructure and hardness of steel. Smoljan et al. suggested the modified Jominy-test for prediction of hardenability of cold work tool steels. The investigated modified Jominy-test in simulation of tool quenching was estimated by comparison of the cooling curves of a modified Jominy-specimen (JM®-specimen) and a cylindrical specimen.

Garbiak and Piekarski present research of aluminium-based protective coatings applied on creep-resistant parts of carburising furnaces. The coatings were fabricated by pack cementation and by slurry cementation on samples of G-X35NiCrSi 38-18 cast steel. The phase constitution, thickness and microhardness of coatings were examined. It has been proved that the selected coatings are capable of protecting for 1000 workhours the creep-resistant metallic parts of carburising furnaces from the carburising effect under the conditions of thermal shocks.

Michalski et al. presented results of nitriding of chromium-molybdenum-aluminum steel without the white layer and created a mathematical relationship changing the nitriding potential during process. By running the process kinetic maximum nitriding can be achieved as well as avoidance of formation of nitrides of compound layer. Mridha investigated growth kinetics of a nitrided layer on En40B steel at various temperature in gaseous environments containing 10–80% of ammonia. The nitriding conditions were selected to given specimens with and without the white layer. A metallographic technique was used to reveal different zones and their thickness of the nitrided surface layer. He found out that the growth rate of the nitrided layer reached to a maximum with the increase of ammonia content in the gas mixture where the thickness of the white layer is minimum. Rus et al. discussed the influence of ion nitriding on thermal shock behaviour of two austenitic and martensitic stainless steels. The specimens' surface were examined by means of optical microscopy in order to determine the number of cycles until the formation of the first cracks, number of crack, and cracks length.

Torres et al. study the paste boriding process. In particular, a dimensional method is used to study the growth kinetics of the boride layers FeB and Fe_2B. The model is based on the creation of groups of variables in power product form. Experiments were performed on AISI 1045 steel and AISI M2 steel, to test the suggested model.

Samples of 1045 steel were prepared and treated using boron paste of various thickness and at different temperature-time conditions. Results indicate that the growth of boron layers obeys power laws of the exponential form, where constants are a function of the material and the interface of interest.

Betiuk et al. present a possibility of using metalorganic compounds in Plasma-Assisted PVD (PAPVD) method. The objective of the new technology of the MOPVD-ARC multilayer is to produce plasma atmosphere of trimethylaluminium $Al\ (CH_3)_3$ as one of the most widely used aluminium precursors in Metalorganic CVD (MOCVD).

Ugues et al. studied a CrAlSiN coating system deposited on the base material, modulating the chemical composition so as to increase either the chromium or the aluminum-silicon content.

Coated specimens were analysed with optical and electronic microscopy in order to assess the overall quality. Another set of specimens was subjected to a cyclic immersion test in a molten aluminum bath where washout signs were detected and monitored as a function of the number of cycles.

Yuri et al. presented CVD tungsten/tungsten carbide coatings called Hardide. The coatings consist of tungsten carbide nano-particles dispersed in metal tungsten matrix, giving hardness ranging between 1100 HV and 1800 HV, and an essentially better abrasion resistance than Hard Chrome. Nano-structured materials show unique toughness, crack and impact-resistance.

Special thanks are due to the authors contributing their papers to this special issue of the IJMMP. They are a result of very critical work of reviewers and the authors. It can be said that the papers satisfy high standards of quality.

Our great thanks are due also to our co-workers, Mr. Franc Ravnik BSc, and Ms. Nevenka Majerle, who took care of the coordination among the reviewers and the authors, and prepared the papers for the publication.

We sincerely hope that the papers presented on heat treatment and surface engineering of tools and dies will be a valuable source of information to researchers in various scientific fields, and users in the field of materials and production.