



IX INTERNATIONAL CONFERENCE «MATHEMATICAL MODELLING AND INFORMATION TECHNOLOGIES IN WELDING AND RELATED PROCESSES»

IX International Conference «Mathematical modelling and information technologies in welding and related processes» — MMITWRP-2018 was held on September 10–14, 2018 in Odessa at «Kurortnyi» hotel.

The Conference was organized by the International Association «Welding».

This Conference has become traditional starting from 2002 and every two years gathers the specialists in the field of mathematical modelling of physical processes taking place in welding from different countries of the world.

45 scientists and specialists from Ukraine and Belarus as well as specialists from Germany with remote participation took part in the Conference work, which was organized in form of sessions of plenary and post- presentations.

The Conference was opened by the head of the Program Committee Prof. I.V. Krivtsun. In his speech he fixed on the problems, possibilities and tasks of mathematical modelling and theoretical analysis of the physical processes in the field of welding and related technologies.

Let's note some presentations, which give an idea of the discussed Conference topics:

- «Effect of current and arc length on characteristics of arc discharge in nonconsumable electrode welding», *Krivtsun I.V., Demchenko V.F., Krikent I.V., Kovalenko D.V.*, E.O. Paton Electric Welding Institute (PWI);

- «Modelling of residual stresses in welded joint of header to nozzle of steam generator PG-1000M», *Makhnenko O.V., Muzhichenko A.F., Saprykina G.Yu.*, PWI;

- «Mathematical modelling of heat, electro- and hydrodynamic processes in ESK of forging ingots of alloyed steels», ¹*Sibir A.V.*, ^{2,3}*Medovar L.B.*, ¹*Gubinsky M.V.*, ²*Polishko A.A.*, ^{2,3}*Stovpchenko A.P.*, ²*Kolomiets D.V.*, ¹National Metallurgical Academy of Ukraine, Dnepr, ²PWI, ³«Elmet-Roll», Kyiv;

- «Calculated estimation of thermal cycles in friction welding of dissimilar nickel alloys», *Zyakhor I.V., Velikoivanenko E.A., Rozynka G.F., Zavertanny M.S.*, PWI;

- «Nonstationary processes in arc plasma and welded metal in TIG welding with high-frequency current modulation», *Demchenko V.F., Krivtsun I.V., Krikent I.V., Abdulakh V.M.*, PWI;

- «Effect of preheating on thermal cycle of argon-arc welding of sparsely-doped titanium alloys», *Akhonin S.V., Belous V.Yu., Selin R.V.*, PWI;



Presentation of Prof. I.V. Krivtsun

- «Complex mathematical model of the process of plasma-induction growing of single-crystals of refractory metals», *Gnizdylo A.N., Shapovalov V.A., Yakusha V.V.*, PWI;

- «Investigation of thermal fields in reaction brazing under conditions of local heating of joint zone» ¹*Kulinich M.V.*, ²*Zaporozhets T.V.*, ²*Gusak A.M.*, ¹*Ustinov A.I.*, ¹*Kosintsev S.G.*, ¹PWI, ²Bogdan Khmelnytsky National University of Cherkassy;

- «Modelling of thin-wall cylinder shells produced by additive method», *Kostin V.A.*, PWI;

- «Effect of residual welding stresses on evaluation of fracture resistance of elements of WWER-1000 reactor internals for substantiation of operation extension», *Makhnenko O.V., Kandala S.M., Savitskaya E.M.*, PWI;

- «Shape of welding current pulses optimum by force action», ¹*Demchenko V. F.*, ¹*Krivtsun I.V.*, ²*Nomirovsky D.A.*, ¹PWI, ²Taras Shevchenko National University of Kyiv;

- «Effect of mode of arc welding on formation of metastable phases in weld metal and HAZ of high-strength pseudo β -titanium alloy VT19», *Belous V.Yu., Kostin V.A., Grigorenko G.M., Selin R.V., Grigorenko S.G.*, PWI;

- «Effect of technological parameters of submerged-arc surfacing of anticorrosive layer in nozzle zone of WWER-1000 RV on distribution of residual stresses», *Makhnenko O.V., Kostenevich E.S.*, PWI;

- Mathematical modelling of wire melting and detachment of drops in arc welding», ¹*O. Semenov*, ¹*I. Krivtsun*, ²*U. Reisgen*, ²*A. Schiebahn*, ²*O. Mokrov*, ²*M. Simon*, ²*R. Sharma*, ²*P. Lozano*, ²*S. Mann*, ¹PWI, ²Institute of Welding and Joining, RTWH, Aachen, Germany;

- «Prediction of microstructure and mechanical properties in layer-by-layer formation of products from titanium alloy VT6 using EBW», *Makhnenko O.V.*, *¹Kandala S.M.*, *¹Ananchenko N.S.*, *²Kovalchuk D.V.*, *¹PWI, JSC «Chervona Hvilya»*, Kyiv;
- «Mathematical modelling of combined process of ESR + CC for production of high-quality rail steel», *¹Sibir A.V.*, *^{2,3}Medovar L.B.*, *¹Gubinsky M.V.*, *¹Polishko A.A.*, *^{2,3}Lebed V.A.*, *¹National Metallurgical Academy of Ukraine, Dnepr*, *²PWI*, *³«Elmet-Roll»*, Kyiv;
- «Mathematical modelling of process of formation of stress-strain state in laser treatment», *Devojno O.G.*, *Kardapolova M.A.*, *Pilipchuk A.P.*, *Belarusian National Technical University, Minsk*;
- «Structural transformations in welded joints of HPP steam lines», *Dmitrik V.V.*, *Glushko A.V.*, *NTU «Kharkiv Polytechnic Institute»*;
- «Prediction of peculiarities of kinetics of thermo-deformed state of compact specimens of different geometry in their layer-by-layer forming on xBeam 3D Metal Printer equipment», *Makhnenko O.V.*, *Milenin A.S.*, *Velikoivanenko E.A.*, *Rosynka G.F.*, *Pivtorak N.I.*, *Kozlitina S.S.*, *Dzuybak L.I.*, *Kovalchuk D.V.*, *PWI*;
- «Physical modelling of processes of melting, hydrodynamics and metal solidification in electroslag technologies», *Protokovilov I.V.*, *Porokhonko V.B.*, *PWI*;
- «Modelling of processes of external electromagnetic effect in underwater welding», *¹Maksimov S.Yu.*, *¹Prilipko E.A.*, *²Krazhanovsky D.M.*, *²Vinnichuk S.D.*, *¹PWI*, *²Pukhov Institute for Modelling in Energy Engineering, Kyiv*.

A round-table «Processes of welding and related technologies: theoretical investigations, mathematical modelling, calculation experiment» (moderators — Acad. of the NAS of Ukraine I.V. Krivtsun and Prof. V.F. Demchenko) was held during the Conference.

In his speech I.V. Krivtsun noted that one of the key problems of modern industrial production is improvement of existing and development of new high-performance technologies of joining and processing of metallic materials. Among them there are, for example, such technological processes as fusion welding, surfacing, coating spraying, heat treatment of surface, arc refining of steels. At current stage of development of welding and related technologies solution of this problem is impossible without detailed investigation of collection of physical phenomena (heat, diffusion, gas-, hydrodynamic, electromagnetic, optical, etc.), taking place at interaction with welded or treated material of different sources of heat energy. This is gas-discharge, first of all arc, plasma, electromagnetic, in particular, laser radiation or their combination.

Experimental investigation of physical nature of such multifactor interaction is connected with sig-

nificant difficulties, caused by high values of plasma temperature and surface of material being treated in a zone of effect of heat source, small geometry sizes of the indicated zone, high rates of investigated processes and series of other circumstances. Besides, received experimental data, as a rule, reflect cumulative result of effect of the whole complex of physical processes taking place in a system «heat source-material being treated» at that to detect a role of each of them in formation of resulting effect appears to be sufficiently difficult problem. Therefore, in the recent decades the methods of theoretical investigation, including development of mathematical models, as well as appearing with development of computer engineering numerical methods and packets of application programs for complex computer modelling of physical processes in welding and material processing attract more and more attention of the specialists. Such an approach allows significantly reducing the expenses connected with performance of large amount of expensive full-scale experiments, since provides the possibility of sufficiently quick and relatively cheap qualitative and quantitative analysis of the processes taking place in the considered system, for wide range of conditions and parameters of mode of welding or treatment, characteristics and properties of welded or treated material. Besides, what is particularly important, numerical modelling allows investigating the effect on a predicted result of the technological process of each of considered by model physical phenomena separately and, thus, determining the optimum ways and methods of improvement of technology and equipment under study for its realization.

V.F. Demchenko stopped on those tendencies, which take place in the field of mathematical modelling of welding and related processes in the recent years. In particular, he noted that there is increase of number of researches using standard packets of the application programs for integration of mathematical physics equations.

Proceedings of MMITWRP-2018 Conference will be published till the end of 2018. These proceedings as well as proceedings of the previous eight International Conferences MMITWRP can be ordered in the editorial board of «The Paton Welding Journal» or get in e-form in open access on website of the Paton Publishing House <http://patonpublishinghouse.com/rus/proceedings/mmw>.

The next, X International Conference «Mathematical modelling and information technologies in welding and related processes» is planned to be carried out in Odessa in September 2020.

Dr. A.T. Zelnichenko