

EDITORIAL BOARD

Editor-in-Chief

Igor Krivtsun

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Deputy Editor-in-Chief

Michael Gasik

Aalto University, Espoo, Finland

Deputy Editor-in-Chief

Jacob Kleiman

Integrity Testing Laboratory, Markham, Canada

Editorial Board Members

Serhii Akhonin

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Olena Berdnikova

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Chunlin Dong

Guangzhou Jiao Tong University, China

Shiyi Gao

China-Ukraine Institute of Welding,
Guangdong Academy of Sciences, Guangzhou, China

Len Gelman

The University of Huddersfield, UK

Andrey Gumenyuk

Bundesanstalt für Materialforschung und -prüfung (BAM),
Berlin, Germany

Vitalii Knysh

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Volodymyr Korzhyk

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Victor Kvasnytskyi

NTUU «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine

Leonid Lobanov

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Eric Macdonald

The University of Texas at El Paso, USA

Serhiy Maksymov

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Dhanesh G. Mohan

School of Engineering University of Sunderland England,
United Kingdom

João Pedro Oliveira

Universidade NOVA de Lisboa, Portugal

Mykola Pashchin

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Valeriy Pozniakov

E.O. Paton Electric Welding Institute of the NASU, Kyiv, Ukraine

Uwe Reisinger

Welding and Joining Institute, Aachen, Germany

Massimo Rogante

Rogante Engineering, Civitanova Marche, Italy

Cezary Senderowski

Mechanics and Printing Institute, Warsaw University
of Technology, Poland

Magdalena Speicher

Kempen University of Applied Sciences, Germany

Mattias Thuvander

Chalmers University of Technology, Goteborg, Sweden

Valentyn Uchanin

Karpenko Physico-Mechanical Institute of the NASU, Lviv, Ukraine

Gerald Wilhelm

University of Applied Sciences of Munich, Germany

Yongqiang Yang

South China University of Technology, Guangzhou, China

Executive Editor

Oleksandr Zelnichenko

International Association "Welding", Kyiv, Ukraine

Address of Editorial Office

E.O. Paton Electric Welding Institute, 11 Kazymyr Malevych Str., 03150, Kyiv, Ukraine
Tel.: (38044) 205 23 90, E-mail: patonpublishinghouse@gmail.com; journal@paton.kiev.ua
<https://patonpublishinghouse.com/eng/journals/tpwj>

The Journal was registered by the National Council of Ukraine on Television and Radio Broadcasting on 09.05.2024,
carrier identifier R30-04569; ISSN 0957-798X; DOI: <http://dx.doi.org/10.37434/tpwj>

Subscriptions, 12 issues per year:

348 Euro — annual subscription for the printed (hard copy) version, air postage and packaging included;

288 Euro — annual subscription for the electronic version (sending issues in pdf format or providing access to IP addresses).

Representative Offices of "The Paton Welding Journal":

BRAZIL, Arc Dynamics

Address: Nova Iguacu, Rio de Janeiro, Brazil

Daniel Adolpho, Tel.: +55 21 9 6419 5703, E-mail: dadolpho@arcdynamics.com.br

BULGARIA, Bulgarian Welding Society

Address: Blvd. Asen Yordanov No.10, Sofia 1592, Bulgaria

Pavel Popgeorgiev, Tel.: +359 899 96 22 20, E-mail: office@bws-bg.org

CHINA, China-Ukraine Institute of Welding, Guangdong Academy of Sciences

Address: Room 210, No. 363 Changxing Road, Tianhe, Guangzhou, 510650, China

Zhang Yupeng, Tel.: +86-20-61086791, E-mail: patonjournal@gwi.gd.cn

POLAND, PATON EUROPE Sp. z o. o.

Address: ul. Kapitałowa 4, 35-213, Rzeszów, Poland

Anton Stepakhno, Tel.: +38067 509 95 67, E-mail: Anton.Stepakhno@paton.ua

The content of the Journal includes articles received from authors from around the world in the field of welding, cutting, cladding, soldering, brazing, coating, 3D additive technologies, electrometallurgy, material science, NDT and selectively includes translations into English of articles from the following journals, published in Ukrainian:

- «Автоматичне Зварювання» (Automatic Welding), [https://patonpublishinghouse.com/eng/journals/as](https://patonpublishinghouse.com/eng/journals/as;);
- «Suchasna Elektrometalurhiya» (Electrometallurgy Today), [https://patonpublishinghouse.com/eng/journals/sem](https://patonpublishinghouse.com/eng/journals/sem;);
- «Tekhnichna Diahnostyka ta Neruinivnyi Kontrol» (Technical Diagnostics & Nondestructive Testing), <https://patonpublishinghouse.com/eng/journals/tdnk.>

CONTENTS

ORIGINAL ARTICLES

- V.S. Kachynskiy, D. Allford, M.P. Drachenko, I.V. Ziakhor, V.I. Klymenko, S.M. Samotryasov**
DEVELOPMENT OF THE TECHNOLOGY OF PRESSURE WELDING WITH A MAGNETICALLY IMPELLED ARC OF SMALL-DIAMETER PIPES USING SUPERCAPACITORS* 3
- Ke Liming, P.D. Stukhliak, V.M. Mudrichenko**
FEATURES OF THE STRUCTURE OF COATINGS OF TUNGSTEN AND CHROMIUM CARBIDES DURING DETONATION-GAS SPRAYING WITH ENERGY ACCUMULATION IN A MULTICHAMBER DEVICE* 11
- N.V. Vihilianska, O.M. Burlachenko, O.P. Gryshchenko, I.O. Koziakov, V.F. Gorban**
FORMATION OF COATINGS OF THE FeTi–SiC SYSTEM DURING THERMAL SPRAYING OF POWDER PRODUCED BY THE METHOD OF MECHANOCHEMICAL SYNTHESIS* 19
- Z. Mirijanashvili, G. Dadianidze, O. Tsagareishvili, B. Salaridze, L. Chkhartishvili**
OBTAINING WEAR-RESISTANT COATINGS BY SURFACING WITH POWDER CORE WELDING WIRE 26
- A.A. Babinets**
USING THE HEREDITY EFFECT FOR CONTROL OF THE STRUCTURE OF THE DEPOSITED METAL DURING ELECTRIC ARC SURFACING WITH FLUX-CORED WIRES (REVIEW)* 30
- S.V. Petrov, S.G. Bondarenko, Sh. Roshanpour, A.M. Shakhnovsky**
CONTINUOUS PRODUCTION OF LARGE VOLUMES OF PLASMA ACTIVATED WATER FOR AGRICULTURE 42

INFORMATION

- 77th ANNUAL ASSEMBLY OF THE INTERNATIONAL INSTITUTE OF WELDING AND INTERNATIONAL WELDING AND JOINING CONFERENCE 54
- VII INTERNATIONAL CONFERENCE “WRT-2024” 56

*Translated Article(s) from “Avtomatychne Zvaryuvannya” (Automatic Welding), No. 5, 2024.



Indexing: The electronic edition of the Journal is stored in the V.I. Vernadsky National Library of Ukraine (eVerLib), included in the OPEN UKRAINIAN CITATION INDEX database and international databases: CROSSREF, EBSCO, Google Scholar, INDEX COPERNICUS, IET Inspec, ULRICHSWEB.

77th ANNUAL ASSEMBLY OF THE INTERNATIONAL INSTITUTE OF WELDING AND INTERNATIONAL WELDING AND JOINING CONFERENCE



This year the 77th Annual Assembly of the International Institute of Welding and the International Conference on Welding and Joining took place from July 7 to 12 on the island of Rhodes in Greece at the Rhodes Palace Hotel and Convention Center. This prestigious international event brought together experts from around the world to discuss the latest developments and innovations in welding technologies. Prominent industry representatives and researchers shared their findings and discussed future trends in the field. Almost 1000 participants from 51 countries also had the opportunity to attend seminars and networking events to deepen their knowledge and make new contacts.

Such events are extremely important for Ukrainian scientists, especially under the conditions of modern challenges that the scientific community of Ukraine is facing. Participation in international conferences, such as the Annual Assembly of the International Institute of Welding, provides an opportunity to exchange experience with colleagues from around the world, and to become familiar with the latest scientific achievements and technologies. For Ukrainian researchers, this is also an important step towards integration into the world scientific community, establishment of new international contacts and involvement in the joint projects. Years of pandemic and military aggression in the territory of Ukraine significantly limited the opportunities for direct communication with colleagues from other countries. Therefore, the chance to participate in the 77th IIW Annual Assembly and the International Conference was used to the maximum.

Thanks to the support of the Ministry of Education and Science of Ukraine, CRDF Global, the team of the In-



ternational Institute of Welding and the Greek Institute of Welding, the Ukrainian delegation, led by Illia Klochkov, Academic Secretary of the E.O. Paton Electric Welding Institute of the National Academy of Sciences of Ukraine, representative of Ukraine in IIW, Cand. of Sci. (Eng.) went to Greece. The delegation also included Maksym Iurzhenko, the Corresponding Member of the National Academy of Sciences of Ukraine, Dr. of Sci. (Eng.), Head of the Plastics Welding Department and Sviatoslav Motrunich, Cand. of Sci. (Eng.), Senior Staff Scientist of the Department of Welded Structure Strength.



The heat that prevailed this July in Kyiv is difficult to compare with that on the island of Rhodes. However, in the halls where this scientific event was held, the atmosphere was even hotter: reports, speeches, presentations, discussions on the sidelines, meetings with old colleagues and new acquaintances — all this created a unique atmosphere of the event. Here are the official statistics of registered participants:

- full members — 466;
- full participants (young specialists) — 147;
- full participants (students) — 205;
- participants of the International Conference — 25;
- participants of the International Conference (students and young specialists) — 17;
- accompanying persons — 68;
- participants of the Symposium on “Intelligent Manufacturing” — 11.

Germany was the most represented this year with 155 participants. It is followed by China — 132, Greece — 128, Japan — 86, USA — 81, South Korea — 68.

The Ukrainian delegation, together with representatives of the Institute, who presented their reports online, consisted of ten scientists. They were Maksym Khokhlov, who presented the report on “Thermomechanical

processes in zones of FSW butt joints of sheet magnesium alloy”, Svitlana Maksymova — “Influence of Ge and In on the structure and thermodynamic characteristics of high-entropy MnCoNiCu alloys”, Oleksandr Yarovytsyn — “On the issue of probability assessment and prevention of the occurrence of the “immersion plasticity cracking” mechanism in the conditions of the process of 3D multilayer deposition with a welding arc on nickel and cobalt alloys”, Serhiy Maksymov — “Effectiveness of application of the pulsed nature of arc burning in wet underwater welding”, Serhiy Schwab — “Production and application of powder of a biomedical titanium alloy of Ti–Zr–Nb system in metal flux-cored wire for WAAM technology”, Roman Selin — “Narrow-gap welding of titanium alloy samples with a width of 45–60 mm by a controlled magnetic field”, Yevgenia Chvertko — “Welding of rod artistic constructions”.

One of the main areas of PWI activity is to attract young scientists to the technology sector, to promote their professional development and integration into the international scientific and technical community. The Institute recognizes the importance of training a new generation of researchers and welding engineers capable of not only supporting but also promoting advanced technologies in the field of welding and materials science. For this purpose, PWI supported the participation of its young talents in the online format in the meetings of IIW Working Commissions. Thanks to such support, young Ukrainian scientists had the opportunity to participate in the discussion of the latest scientific and technical achievements.

Members of the Ukrainian delegation, who had the opportunity to attend the event on the Greek island, presented the following reports: Maksym Iurzhenko — “High-speed welding of polymer materials”, Sviatoslav Motrunich — “High-cycle fatigue of 3D-printed titanium alloy TA15 produced by electron beam additive manufacturing”, “Manufacture of a high-hardness, high-entropy, tantalum-doped eutectic alloy using arc additive manufacturing” and “Structural integrity of 3D-printed Ti–6.5Al–1Mo–1V titanium alloy billets”. It should be noted that Sviatoslav Motrunich presented reports both at the meeting of the relevant Working Commission and at the International Conference on Welding and Joining.

As part of IIW activities, a tradition has been established long ago of honoring those who have achieved significant results in welding and related areas. These awards received their names in honor of outstanding personalities who were the founders of IIW or made a significant contribution to the development and implementation of scientific and technical achievements in the field of welding, joining and related processes. Usually, the award ceremony takes place during the official opening ceremony of the event. In 2024, the award winners were:

- Fellow of the IIW, awarded to Károly Jármai, Patricio Mendez, Gerhard Posch, Volker Schöppner, Chuan-song Wu and Yixiong Wu;
- Evgeny Paton Award — Suck-Joo Na;

- Arthur Smith Award — David Fink;
- Yoshiaki Arata Award, — Boian Alexandrov;
- Thomas Medal — Teresa Melfi;
- Chris Smallbone Award — Emmanuel Afrane Gyasi;
- Walter Edström Medal — John C. Lippold;
- Henry Granjon Category A Award — Rui Yu;
- Henry Granjon Category B Award — Derek Shaffer;
- Henry Granjon Category C Award — Aravindh Nammalvar Raja;
- Halil Kaya Gedik Award — Sergio Amancio
- Welding in the World Best Paper Award, Category A: Welding Processes and Additive Manufacturing awarded to Florian Muller;
- Welding in the World Best Paper award, Category B: Materials and Metallurgy awarded to Nellikode Savvasachi;
- Welding in the World Best Paper Award, Category C: Structural Integrity, Design and Fitness for Service awarded to Kalle Lipiäinen;
- André Leroy Prize — Guy Brooks & Michael Pitt.

Almost 30 years ago, our Institute established one of IIW most prestigious awards — the Evgeny Paton Prize. According to the results of a secret vote, which was held among the representatives of member countries of the International Institute of Welding, this year’s winner among many applicants was Suck-Joo Na, Professor of the Korea Advanced Institute of Science and Technology. The award was presented to the laureate by Illia Klochkov, Academic Secretary of the E.O. Paton Electric Welding Institute of the National Academy of Sciences of Ukraine.

For its part, the International Institute of Welding recognized a Ukrainian representative for her significant contribution to the activities of the governing bodies of this international organization during 2021–2024. The award was given to Yevgenia Chvertko, former IIW Vice-President, who, with her tireless work, contributed to the strengthening of Ukraine’s position in this organization.

Representatives of the Ukrainian delegation held a series of meetings in Rhodes — from short greetings to long, substantive negotiations. Each of these meetings had its own importance, as they created the basis for establishing new professional contacts and strengthening the already existing partnerships. We sincerely hope that these negotiations will bring mutually beneficial results for both parties.

I would especially like to note the meeting with David Lake, President of Weld Australia organization, the head of the organization, which at a very difficult time for Ukraine initiated support for us within the international welding community, thereby helping and continuing to help the promotion of the Institute, and Ukraine as a whole, in the international arena. We are grateful to Weld Australia for both significant financial support and willingness to cooperate within bilateral and multilateral agreements.

In Rhodes, the Ukrainian delegation actively promoted the activities of the Institute. Particular attention was paid to the presentation of the International Conference “Welding and Related Technologies 2024”, which will

be held from October 7 to 10, 2024 in the picturesque city of Yaremche (Ukraine). This event should become a unique platform for the exchange of experience between scientists, engineers and industry specialists, promote the development of international cooperation, as well as popularization of the latest achievements in the field of welding and related technologies. The Conference has already aroused considerable interest among potential participants from different countries of the world, which makes it one of the key events of the year in the field of welding in Ukraine.

This year's meeting in Rhodes became an ideal place for a substantive exchange and professional communication around the topic of welding and related fields. If we summarize the work of the 77th Annual Assembly of the International Institute of Welding and the International Conference on Welding and Joining, then, according to official information:

- in the period from July 7 to July 12, 2024, 18 meetings of IIW Commissions and Working Groups were held;
- at the International Conference “Energy Infrastructures and Transportations across the seas”, held on July 11 and 12, 2024, 87 presentations were made and 17 posters were presented;
- social events included an opening ceremony and awards ceremony, an Ice Breaking event for young professionals, a welcome reception, a Greek night and a closing ceremony at the gala banquet;
- presentation of sponsors' products took place;
- a photo exhibition of a collection of works of art made using the welding methods was held.

And what next... Next we will look forward to 2025, when the 78th IIW Annual Assembly and International Conference on Welding and Joining is scheduled to take place in Magazzina del Cotone in Genoa, Italy, from June 22 to 27.

Editorial Office of the Journal

VII INTERNATIONAL CONFERENCE “WRT-2024”

On October 7–10, 2024, the VII International Conference “Welding and Related Technologies WRT-2024” was held in Yaremche, Ukraine, bringing together scientists from Australia, Canada, China, Czech Republic, France, Germany, Israel, Italy, Japan, Mexico, Poland, Ukraine, USA, and representatives from more than 30 research organisations, private companies and industrial enterprises. The event was held in a mixed format. The working language of the Conference was English.

The VII International Conference “Welding and Related Technologies WRT-2024” was held as an associated event of the International Institute of Welding (IIW) and with the financial support of the US Civilian Research and Development Foundation (CRDF Global). The Conference was organized by the E.O. Paton Electric Welding Institute of the NAS of Ukraine. The International Association “Welding” and the NGO “Virtus” were co-organizers of the Conference.

A total of 159 participants from 13 countries of the world took part in the event. Interesting presentations from 5 invited speakers were heard. 18 specialists in the field of welding and related technologies presented the results of their research and development works in person, 20 scientists spoke online, and 19 participants made poster presentations. An online section was also held in parallel at the E.O. Paton Electric Welding Institute of the NAS of Ukraine in Kyiv.

The most popular topic area of the Conference in terms of the number of presented papers was “Innovative technologies, materials and equipment for welding and related processes” — 19 papers, 10 papers were presented in the topic “New structural and functional materials, nanomaterials, composites”, the topic areas “Mathematical modelling of welding and related processes”, “Non-destructive testing and technical diagnostics” and “Modern technologies of special electrometallurgy” were presented in 7 papers each, and 6 papers were presented in the topic area “Additive technologies”.

It is worth noting the extremely positive atmosphere of the event, the high level of speakers, fruitful exchange of opinions and interesting communications. All the presentations aroused great interest, which was reflected in the inspired, lively discussions among the participants and the audience. Thus, all participants had a great opportunity to enrich their knowledge and exchange experiences. Welding science and technologies are alive in Ukraine and around the world and have significant development prospects.

We invite everybody to participate in the VIII International Conference “Welding and Related Technologies WRT-2026” in 2026!

Editorial Office of the Journal