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SHORT COMMUNICATION

Three decades of research excellence

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ABSTRACT

The Kosice Summit of Innovation and Technology (KSIT 2024) was held in Železiarne Podbrezová a.s. facilities from November 2-5, 2024, at the Hotel Stupka. The conference was organised to mark the 30th anniversary of founding the scientific journal Acta Metallurgica Slovaca. KSIT 2024 also covers some interesting topics. More lectures are presented on issues related to additive manufacturing (AM). Given the expanding and invaluable role of simulation tools, which can currently be applied to various production processes, an interesting lecture was given at the KSIT conference regarding using the simulation tool Simufact Additive. Current knowledge was also presented in the field of joining materials focused on hybrid methods of joining materials, especially sheets used in producing car bodies. Currently, the concepts of materials used for car bodies differ significantly, with the goal being to reduce the body's weight, thereby reducing fuel consumption and, on the other hand, increasing the passive safety of the crew. Individual car manufacturers' body construction concepts use different materials, such as ferrous and non-ferrous metals.

Keywords: additive manufacturing; innovation; hybrid joining; aluminium; steel

Kosice Summit of Innovation and Technology

The Kosice Summit of Innovation and Technology (KSIT 2024) was held in Železiarne Podbrezová a.s. facilities from November 2-5, 2024, at the Hotel Stupka. The conference was organised to mark the 30th anniversary of the founding of the scientific journal Acta Metallurgica Slovaca (**Fig 1**).

Fig. 1 Presentation related to the 30th anniversary of the Acta Metallurgica Slovaca; left prof. Tibor Kvačkaj, founder editor; right Dr. Róbert Bidulský, editor-in-chief

Since its inception, the scientific and professional journal has undergone positive qualitative changes, and today, it is indexed in the world scientific databases Web of Science and SCOPUS.
The quality and prestige of the journal are under the supervisors of the members of the editorial board, namely:

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Wei Wei, Changzhou University, China
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The event celebrated the 30th anniversary of the renowned professional journal Acta Metallurgica Slovaca. It brought together experts in metallurgy, materials science, and industry from Slovakia, the Czech Republic, Poland, and Romania. Over 30 lectures were given during the event. Important speeches were given by Ing. Miloš Dekrét (**Fig. 2, left**), a Member of the Board and Production Director at Železiarne Podbrezová, a.s.. He gave a presentation outlining the company's current developments and challenges. He emphasized the value of sharing knowledge and experience among industry professionals to address challenges and foster innovation. Professor Marcin Staszuk (**Fig. 2, right**), Silesian University of Technology, Gliwice, partner of Bodva Industry and Innovation Cluster in cooperation and co-partner of the KSIT 2024, presents an overview of SUT results.

Fig. 2 Presenters during the KSIT, left Ing. Miloš Dekrét, Member of the Board of Directors and Production Director, Železiarne Podbrezová a.s.; right prof. Marcin Staszuk, Silesian University of Technology, Gliwice, Poland

Professor Ľudmila Kučerová (**Fig. 3**, **left**) and Dr. Jaroslav Kováčik (**Fig. 3**, **right**) show the last research outputs from the University of West Bohemia, Czech Republic, and the Institute of Materials and Machine Mechanics, Slovak Academy of Science.

Fig. 3 Presenters during the KSIT, left prof. Ľudmila Kučerová, University of West Bohemia, Czech Republic; right Dr. Jaroslav Kováčik, Institute of Materials and Machine Mechanics, Slovak Academy of Science

A very nice part of the conference was the congratulations of the Dean of the Faculty of Mechanical Engineering, TUKE Dr.h.c. mult. prof. Ing. Jozef Živčák, DrSc., MPH. on the birthday of the Head of the Institute of Technological and Materials Engineering, Faculty of Mechanical Engineering TUKE prof. Ing. Emil Spišák, CSc. The Dean of the Faculty of Mechanical Engineering also awarded the founder of the journal Acta Metallurgica Slovaca and the President of the Organizing Committee prof. Ing. Tibor Kvačkaj, DrSc. with the Gold Medal of Faculty of Mechanical Engineering for many years of contribution to science and research.

Fig. 4 Celebration during the KSIT, left prof. Ing. Emil Spišák, CSc., receiving a birthday gift from Dr. h. c. mult. prof. Ing. Jozef Živčák, DrSc., MPH; right prof. Ing. Tibor Kvačkaj, DrSc. awarded with the **Gold medal** of Faculty of Mechanical Engineering

The conference organizers, led by Professor Tibor Kvačkaj, highlighted the long-standing partnership with Železiarne Podbrezová, a.s.. Thanks to the company's support, participants can explore key industry topics, share insights, and discuss future opportunities for collaboration. Moreover, a highlight of the event was the gala dinner (**Fig. 5**), during which Železiarne Podbrezová, a.s. was presented with a commemorative award for its long-standing collaboration with the publishers of Acta Metallurgica Slovaca (**Fig. 6**, **left**). The organizers expressed gratitude for the company's enduring support and significant contribution to the journal's development.

Fig. 5 Ceremony of the Acta Metallurgica Slovaca awards
From left: Dr.h.c., Ing. Vladimír Soták, general manager of Železiarne Podbrezová a.s.; prof. Ing. Tibor Kvačkaj, DrSc.; doc. Ing. Ľuboš Kaščák, PhD.; doc. Ing. Róbert Bidulský, PhD.

On the occasion of the celebration, the editorial board of the Acta Metallurgica Slovaca journal awarded **Fig. 5** - **Fig. 10**, the support of the journal to the following participants:
Dr.h.c., Ing. **Vladimír Soták** - general director of the Železiarne Podbrezová a.s.
Ing. **Vladimír Zvarík** - Železiarne Podbrezová a.s.
Dr.h.c. mult. prof. Ing. **Jozef Živčák**, DrSc., MPH – dean of Faculty of Mechanical Engineering, Technical University of Košice (TUKE)
prof. Ing. **Dušan Katunský**, CSc. – dean of the Faculty of Civil Engineering, TUKE
Dr.h.c. mult. prof. Ing. **Jozef Zajac**, CSc. – dean of the Faculty of Manufacturing Technologies, TUKE
prof. Ing. **Emil Spišák**, CSc. – Head of Department, Department of Technology, Materials and Computer Supported Production, Institute of Technology and Materials Engineering, Faculty of Mechanical Engineering, TUKE
Ing. **Jozef Selín**, PhD. - Faculty of Civil Engineering, TUKE
doc. Ing. **Milan Škrobian**, CSc. - Institute of Materials and Machine Mechanics, Slovak Academy of Science
doc. Ing. **Jana Bidulská**, PhD. – Faculty of Materials, Metallurgy, and Recycling, TUKE

Ing. **Michal Zemko**, PhD. – Executive director of the COMTES FHT a.s., Dobřany, Czech republic

Fig. 6 Awarded Slovakian leaders left: Dr.h.c., Ing. Vladimír Soták, right: doc. Ing. Jana Bidulská, PhD.

Fig. 7 Awarded professors from Faculty of Mechanical Engineering, TUKE, left: Dr. h. c. mult. prof. Ing. Jozef Živčák, DrSc., MPH, right: prof. Ing. Emil Spišák, CSc.

Fig. 8 Awarded professors from Faculty of Cicil Engineering, TUKE, dean of the Faculty prof. Ing. Dušan Katunský, CSc., right Secretary of the Faculty Ing. Jozef Selín, PhD.

Fig. 9 Awarded professors from Institute of Materials and Machine Mechanics, Slovak Academy of Science, doc. Ing. Milan Škrobian, CSc. (left); and Ing. Michal Zemko, PhD., Executive director of the COMTES FHT a.s., Dobřany, Czech republic, (right)

Fig. 10 Awarded Slovakian leader Ing. Vladimír Zvarík, as a member of Hall of Fame – Acta Metallurgica Slovaca (*Sieň Slávy časopisu Acta Metallurgica Slovaca*)

The organizers of the KSIT 2024 conference would like to thank all speakers, conference participants and co-organizers Železiarne Podbrezová a.s.. and Faculty of Mechanical Engineering, Technical University of Kosice and Silesian University of Technology for the successful course of the conference. Namely, the members of the **Organizing Committee**:

Tibor Kvačkaj, The President of the Organizing Committee, Bodva Industry and Innovation Cluster, Moldava n/B, Slovakia
Miloš Dekrét, Member of the Board of Directors and Production Director, Železiarne Podbrezová a.s.
Martin Domovec, Member of the Board of Directors and Technical Director, Železiarne Podbrezová a.s.
Róbert Bidulský, Bodva Industry and Innovation Cluster, Slovakia
Iveta Milanová, Bodva Industry and Innovation Cluster, Slovakia
Ľuboš Kaščák, Technical University of Košice, Faculty of Mechanical Engineering, Slovakia
Jana Bidulská, Technical University of Košice, Faculty of Materials, Metallurgy, and Recycling, Slovakia
Zbigniew Brytan, Silesian University of Technology, Gliwice, Poland

Ján Varga, Technical University of Košice, Faculty of Mechanical Engineering, Slovakia
Lenka Bidulská, Bodva Industry and Innovation Cluster, Slovakia
Matej Bidulský, Bodva Industry and Innovation Cluster, Slovakia
Jakub Zahorček, Bodva Industry and Innovation Cluster, Slovakia.

Also, members of the Scientific Committee assess abstracts submitted for the KSIT and work on the scientific program of KSIT moreover, monitor the progress of the scientific program at the KSIT, namely:

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Emil Spišák, Faculty of Mechanical Engineering, Technical University of Kosice, Slovakia
Tomasz Trzepieciski, Rzeszów University of Technology, Poland
Wei Wei, Changzhou University, China

KSIT 2024 also shows some interesting topics. More lectures are presented on a topic related to additive manufacturing (AM). The author demonstrated that AM is a challenging topic for researchers as an alternative to subtractive and formative manufacturing, such as traditional press-and-sinter or alternative methods SPD [1-3]. In particular, laser powder bed fusion (L-PBF) is suitable for obtaining complex metallic objects thanks to its freedom when selectively sintering the powders [4]. It is, therefore, a process where the geometry of the future part does not play an important role. L-PBF is a layer-by-layer process where a laser beam is applied to melt the metal powders selectively; the molten layer solidifies at a high cooling rate [5]. In metal powders, it is well-known that pores act as crack initiators, and due to their presence, the stress distribution is inhomogeneous across the cross-section and leads to the reduction of the effective load-bearing area [6-10]. A full-density part is created by repeatedly melting and solidifying individual layers without finishing operations (drilling, milling), which makes production more efficient and reduces production time [11,12,13]. Applying metal additive manufacturing allows the design of various structural parts, both simple and complex in shape, for a wide range of industries. Therefore, it is important to understand the process, use different types of materials, and predict errors during the process [14,15]. Adopting a laser source implies using metal powders with proper laser absorptivity [16,17]. Poor absorbance causes defects such as pores, low-quality surfaces, and unmelted powder in the 3D-printed parts. Especially in terms of wear characteristics, which are important parameters for powder metallurgy [18-22].

In metal AM, unmelted powder can be reused [23], with spherical powders being the predominant material [24]. Using a particular powder in the manufacturing process can affect the quality of the final part [25]. During the manufacturing process, parts are thermally stressed due to large thermal gradients, which affect the resulting mechanical properties of the part [26].
Considering the proper manufacturing step, it is fundamental to correlate the starting metal powder size and shape to the main process parameters, like laser power, scanning speed, layer thickness, hatching distance, and the scanning strategy adopted. This strategy differs depending on the L-PBF machine supplier. Still, in all cases, re-melting the previous layers during the fusing of the current layer exposed allows its complete adherence to the rest of the part and a high final density. Once the build is completed, the excess powder must be removed, and the fabricated parts must be detached from the substrate. Usually, this last operation is made after a stress-relieving heat treatment, performed to release the thermal stresses that arise during the L-PBF process, which otherwise could lead to the deformation of the parts and loss of dimensional tolerances [27-30].
Another negative factor is residual stresses, which significantly impact the part's strength and can cause deformation [31,32].
Given the expanding and invaluable role of simulation tools, which can currently be applied to various production processes, an interesting lecture was given at the KSIT conference regarding using the simulation tool Simufact Additive. This software can be applied to the metal additive manufacturing process, and it is possible to predict various errors in the production process concerning the selected input parameters of the process. The authors Kaščák et al. [33-35] brought with their research results a view of new possibilities for using simulation tools for the metal additive manufacturing process, which involves the correlation of a large amount of data processing. This mutual correlation of all parameters in the ongoing metal additive manufacturing process impacts the functionality and properties of the manufactured part [36,37].
Their application in predicting errors during the production process reduces the number of printing failures [38]. Numerical simulations represent an effective tool for understanding production processes, monitoring the interaction of related parameters, and preventing unwanted effects [39-41].
The metal additive manufacturing process brings environmental sustainability that produces less CO2 emissions. This is especially true in the aerospace industry, where manufacturing parts manufactured by metal additives reduce weight and, thus, fuel consumption [42,43].
Current knowledge was presented in the field of joining materials focused on hybrid methods of joining materials, especially sheets used in producing car bodies [44,45]. Currently, the concepts of materials used for car bodies differ significantly, with the goal being to reduce the body's weight, thereby reducing fuel consumption and, on the other hand, increasing the passive safety of the crew. Individual car manufacturers' body construction concepts use different materials, such as ferrous and non-ferrous metals [46,47]. Hybrid joining methods combine two or more joining technologies to create joints whose resulting properties are better than joints that would be created using individual joining techniques [48,49]. In recent years, there has been an increasing interest in the development of hybrid joints, which combine, most commonly, joining techniques such as resistance spot welding [50] or mechanical joining (especially clinching [51,52], clinch-riveting [53-55] and self-piercing riveting [56]). The reason for researching these combined joints is that each of the joining techniques used has its strengths and weaknesses, and by combining them, it is possible to create joints with higher static strength, fatigue strength, and higher energy absorption [57]. The advantages of hybrid joints vary depending on the application and the materials used [58-61].
Numerical simulations are an integral part of optimizing technological processes, including conventional ones such as forming [62], joining [63-66], or machining [67]. The use of simulations in the field of machining can provide a lot of information that is important for obtaining the required dimensional accuracy and quality of final parts [68-70]. This mainly concerns the possibility of predicting errors during the production process, such as undercutting or not finishing the material. Simulations also offer the possibility of closer analysis of the interaction between the cutting tool and the workpiece, which is especially important when machining shaped surfaces - a combination of convex, concave and flat surfaces. It also allows for determining the impact of the choice of milling strategies on the quality of the machined surface, which also significantly affects the roughness of the machined surface [71-74].

Conclusions

The participants agreed that KSIT 2024 events are invaluable for strengthening professional and personal relationships. They serve as a platform for exchanging ideas and experiences, benefiting individual participants and the broader industrial community.

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