World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:18, No:12, 2024

Functional Surfaces and Edges for Cutting and Forming Tools Created Using Directed Energy Deposition

Authors : Michal Brazda, Miroslav Urbanek, Martina Koukolikova

Abstract : This work focuses on the development of functional surfaces and edges for cutting and forming tools created through the Directed Energy Deposition (DED) technology. In the context of growing challenges in modern engineering, additive technologies, especially DED, present an innovative approach to manufacturing tools for forming and cutting. One of the key features of DED is its ability to precisely and efficiently deposit Fully dense metals from powder feedstock, enabling the creation of complex geometries and optimized designs. Gradually, it becomes an increasingly attractive choice for tool production due to its ability to achieve high precision while simultaneously minimizing waste and material costs. Tools created using DED technology gain significant durability through the utilization of high-performance materials such as nickel alloys and tool steels. For high-temperature applications, Nimonic 80A alloy is applied, while for cold applications, M2 tool steel is used. The addition of ceramic materials, such as tungsten carbide, can significantly increase the tool's resistance. The introduction of functionally graded materials is a significant contribution, opening up new possibilities for gradual changes in the mechanical properties of the tool and optimizing its performance in different sections according to specific requirements. In this work, you will find an overview of individual applications and their utilization in the industry. Microstructural analyses have been conducted, providing detailed insights into the structure of individual components alongside examinations of the mechanical properties and tool life. These analyses offer a deeper understanding of the efficiency and reliability of the created tools, which is a key element for successful development in the field of cutting and forming tools. The production of functional surfaces and edges using DED technology can result in financial savings, as the entire tool doesn't have to be manufactured from expensive special alloys. The tool can be made from common steel, onto which a functional surface from special materials can be applied. Additionally, it allows for tool repairs after wear and tear, eliminating the need for producing a new part and contributing to an overall cost while reducing the environmental footprint. Overall, the combination of DED technology, functionally graded materials, and verified technologies collectively set a new standard for innovative and efficient development of cutting and forming tools in the modern industrial environment.

Keywords : additive manufacturing, directed energy deposition, DED, laser, cutting tools, forming tools, steel, nickel alloy
Conference Title : ICPAMT 2024 : International Conference on 3D Printing and Additive Manufacturing Technology
Conference Location : Auckland, New Zealand
Conference Dates : December 02-03, 2024

Open Science Index, Materials and Metallurgical Engineering Vol:18, No:12, 2024 publications.waset.org/abstracts/182220.pdf