3rd EUROFORGE
Milan, Italy / 22–23 Oct 2024
conFAIR 2024
the future of forging

Abstract: Repair of Automotive Forging Dies via Laser Metal Deposition

Abstract refers to the topic

Innovations in Forging Technology

Igor Ortiz[1], Piera Alvarez[1], Maria Azpeleta[1], Diego Montoya-Zapata[1], Francisco Cordovilla[2], José Luis Ocaña[2]

[1]*Ikergune A.I.E. Inzu Group, San Antolin, 3, 20870 Elgoibar, Gipuzkoa, Spain, {iortiz, palvarez, mazpeleta, dmontoya}@ikergune.com*

[2]*UPM Laser Centre. Polytechnical Univ. of Madrid, Alan Turing, 1, 28031 Madrid, Spain, {francisco.cordovilla.baro, joseluis.ocana}@upm.es*

Keywords: Laser metal deposition; Additive manufacturing; Forging die; 1.2344 tool steel, Design for additive manufacturing

Forging dies suffer from wear, cracking and other forms of damage due to the harsh conditions associated to the forging process. Laser Metal Deposition (LMD) offers a precise and efficient alternative for the repair of damaged forging dies. This manuscript presents a methodology for the repair of automotive forging dies using LMD. Compared to other repair methods, LMD is advantageous because (i) it allows the repair of specific regions with high strength alloys like H13 or Stellite 21, (ii) the coating is more homogeneous, (iii) the low heat input that leads to a smaller heat affected zone, (iv) the high control of the toolpaths, (v) the material efficiency, and (vi) the savings in production time as there is no need to wait for the die to cool down before machining.

In this project, we develop and validate a methodology for the LMD-repair of forging dies. The process begins with a thorough assessment of the die condition, identifying the areas in need of repair. Surface preparation involves the cleaning of the die to eliminate contaminants and removal of damaged material. It is sometimes necessary to perform new CAD designs and machine some additional areas to enhance the LMD-repair process. This action is described as design for additive manufacturing. For example, specific chamfers are designed to improve the powder feeding process. In the absence of such chamfers (i.e., wall at 90º), the powder blown may not reach the melt pool, leading to coating defects. The next step is to program the LMD system toolpath. We develop our own software for automatic LMD process planning and toolpath generation, which integrates our know-how on the research of appropriate process parameters for different materials and conditions. We validated the methodology with the repair of an automotive forging die made of F-1140 steel with dimensions 118 mm x 151 mm x 76.3 mm. This die has a life span of 5000-6000 cycles. We repaired the full surface geometry, damaged due to the forging process. The selected coating material was 1.2344 tool steel (H13). The selected die has complex surfaces which highlight the ability of LMD to precisely address intricate geometry. The visual inspection and the

metallographic results show high good quality surface coating and homogeneous bead overlap. We found some localized (lack-of-fusion) defects in the areas of high inclination. Future research will focus on the implementation of toolpaths that improve the coating quality in these regions.

Presenting Author Biography: Igor Ortiz is a research and development project manager for special projects at Ikergune, Inzu Group. He has a Master of Science (MSc) in industrial engineering from Ecole CESI School of engineering and a Master in Business Administration (MBA) from the University of Barcelona (UB). He is sponsored by the company, for carrying out his PhD at the Polytechnic University of Madrid (UPM) and a research stay at Penn State University (PSU) in Laser Metal Deposition (LMD) manufactured gear teeth fatigue analysis. He has more than 10 years of experience in product development, FEA tools and production plants and has been involved in different projects in the automotive and aerospace industries. Currently, he leads the robot laser cell for repair and coating added value parts. Also, he works on software development tools for the automation of laser processes (additive manufacturing, hardening, peening, etc.).