Streamlining the Post-Processing of Customised Additively Manufactured Components

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Additive Manufacturing (AM) is still hampered in many high-standard industries by suitable post-processes. Different post-processing methods are compared on a CoCr medical component that meets the metallurgical surface standards. A novel plasma-electrolytic polishing method is identified as the most promising in terms of surface quality, process costs, and environmental friendliness. By automating this process, this technique has enormous potential.

Introduction and Objective

Despite the successes of additive manufactured (AM) metals, the post-processing, essential for achieving the necessary surface quality and geometrical precision, hampers the use of this technology in hightech industries. This project investigates current and future processes and their combinations on their cost and automation potential. One future technology was particularly in focus because of its potential to use it as a single process after the heat-treatment of the fresly printed metal parts. This plasma-electrolytic jetpolishing (PEP-Jet) technology was used as a proof-of-concept on a CoCr-medical component to compare its cost and surface finishing capabilities with current technologies.

Methods

A mixed method strategy was used, starting with literature review, interviews, and observations to compare polishing methods and their various applications. Quantitative analysis included costs, treatment duration, and surface quality. Experimental work involved programming 3D-computer aided design (CAD) models, generating precise polishing paths, and loading them onto a 6-axis robot for jet polishing, followed by detailed surface analysis to comprehensively compare current post-processing methods.

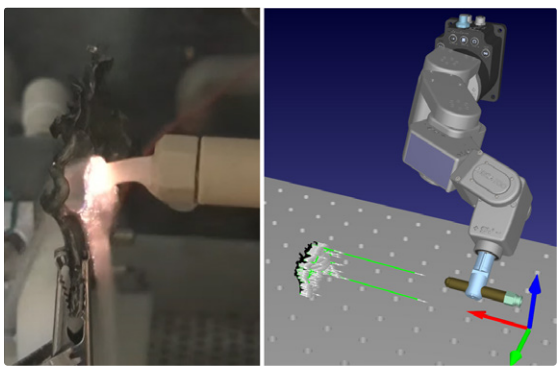

Fig1: PEP-Jet processing a dental prosthesis (left), Virtual model for programming and simulation of the robot (right)

Results

Tests for automated tracing of 3D contours with a 6-axis robot yielded satisfactory results (see Fig.1). The automated PEP-Jet process showed significant potential both economically and qualitatively, since no other pre-polishing is required for AM CoCr workpieces. Thus, the process ensures high surface quality with low costs due to its high automation. Additionally, the PEP-Jet process is environmentally friendly as it uses no hazardous chemicals. The Return in Investment (ROI) analysis confirmed significant cost savings and improved production efficiency compared to conventional methods. Further parameter optimisation makes it possible to make the process even more efficient.

Recommandations

It is recommended to implement the automated PEP-Jet process for post-processing of CoCr workpieces. Fully integrate the 6-axis robot system for precise polishing of 3D contours. Use existing 3D-CAD models (see Fig.2) and computer aided manufactruing (CAM) software to streamline programming for custom-produced implants (see Fig.2). The development of such an industrial machine based on this proof of concept could interest various industries, offering a scalable solution for efficient, high-quality surface finishing of AM parts in various industries. The development of a software that takes over the tasks of the CAM programme and RoboDK at the same time would be an enormous increase in user-friendliness.

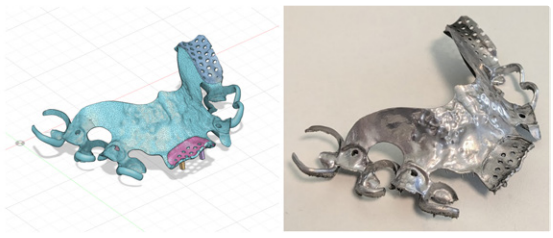

Fig2: 3D-CAD Model of dental prosthesis (left), Additiv manufactured part after twelve PEP-Jet polishing processes

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