Layered Manufacturing of Nanocrystalline Copper Parts Using Pulse Jet Electrodeposition and its Mechanical Properties

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A new type of layered manufacturing technology that combines the jet electrodeposition method and a rapid prototyping concept is presented. The manufacturing method adopts multilayer scanning electrodeposition using an electrolyte jet to fabricate a micro-metallic part with a nanocrystalline microstructure, which simplifies three-dimensional processing. The research results showed that key parameters, including the current density, applied voltage, nozzle diameter and jet speed, impacted the forming process and deposition quality. The effective current density was observed to reach 350 A/dm², at which point nanocrystalline grains with sizes from 30-50 nm were obtained. It was found that the application of an optimized applied voltage, nozzle diameter, current density and jet velocity increased the forming speed and improved the mechanical performance of the finished parts. A group of nanocrystalline copper parts with a good shape and mechanical properties was produced using optimized parameters with the jet electrodeposition method.

Keywords: Layered manufacturing; copper parts; jet electrodeposition; nanocrystalline material

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