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Machining of 3D printed components under CO2

Additive manufacturing enables the rapid production of complex components; however, machining post-processing is often required to achieve final geometry, dimensional accuracy, and surface quality.

For the Medical device sectors, with high cleanliness requirements, the use of conventional oil-based lubricants during machining raises concerns related to contamination, residue retention in porous or lattice structures, and cleaning complexity of 3D-printed parts.

Machining of additively manufactured components presents specific challenges due to their layered architecture, anisotropic properties, and heterogeneous thermal behavior. This study investigates the machining performance of 3D-printed parts under carbon dioxide (CO_2) cooling conditions as a clean alternative to oil lubrication. The effectiveness of CO_2-assisted machining is evaluated in terms of cutting quality, surface integrity, thermal control, and post-machining cleanability.

Experimental results show that CO_2 cooling provides efficient heat dissipation, limits tool wear, and improves surface finish while limiting oil contamination. The low level of lubricant residues significantly enhances the cleanability of machined 3D-printed components, making CO_2-assisted machining a promising solution for applications requiring high cleanliness.