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Application of Microwave Energy to Consolidate Titanium Powder

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Abstract:

Titanium (Ti) has many attractive attributes for military, industrial, and aerospace applications including high specific strength, no magnetic signature, and excellent corrosion resistance. However, its use has been limited by high processing costs. Powder metallurgy is a cost effective way to fabricate high-quality, near-net-shape products. Consolidation of titanium powder compacts is performed in vacuum furnace and the overall processing cycle times can vary from hours to days. Microwave sintering of titanium is a recent development in powder metallurgy of titanium. Microwave sintering is energy efficient compared to conventional sintering methods due to direct microwave heating of the titanium powder compacts via in-depth energy deposition augmented by hybrid heating in a ceramic casket. The in-depth heating enables very rapid processing (cycle times of potentially less than 10 minutes) and ensures that starting fine grain structure is retained in the final product. Microwave sintered titanium alloys display improved mechanical properties and opens up the possibility of superplastic forming. The process can be also used for fabrication of composites, laminates, direct alloying, and functionally graded materials. Evaluations to optimize different parameters for controlling the final density, microstructure, and properties of these materials will be discussed.