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TiAl6V4 bistable mechanism produced by Laser Powder Bed Fusion

The bistable mechanisms use the deformation of the compliant segment (elastic deformation of the material) to transition from one equilibrium position to another. The deformation character eliminates friction and improves the reliability of the mechanism. Both the numerical model and experiments were used to determine the parameters of the bistable mechanism. The mechanism was designed to hold a load of 175 N, which corresponds to the switching force from the second to the first position. Finite element analysis (FEA) was used to determine the influence of the geometry parameters on the switching forces of the bistable mechanism. The material model for the FEA was defined based on the bending properties of TiAl6V4 lamellae, which represent the compliant segment. The modulus of elasticity and yield strength of the material varied with the thickness of the lamellae. The designed mechanism was produced by laser powder bed fusion (LPBF). The results showed good agreement between the experiment and the FEA analysis. The force required for the transition from the second to the first equilibrium position reached 173 N, which fulfilled the initial condition. Therefore, the mechanism could be used in applications that require minimization of energy for long-term control. Typically, these are battery-powered systems in space.

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