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Shape Memory Alloy Structural Damper Manufactured by Selective Laser Melting

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Abstract : Aerospace industry is based on the continuous development of new technologies and solutions that allows constant improvement of the systems. Shape Memory Alloys are smart materials that can be used as dampers due to their pseudoelastic effect. The purpose of the research was to design a passive damper in Nitinol, manufactured by Selective Laser Melting, for space applications to reduce vibration between different structural parts in space structures. The powder is NiTi (50.2 at.% of Ni). The structure manufactured by additive technology allows us to eliminate the presence of joint and moving parts and to have a compact solution with high structural strength. The designed dampers had single or double cell structures with three different internal angles (30°, 45° and 60°). This particular shape has damping properties also without the pseudoelastic effect. For this reason, the geometries were reproduced in different materials, SS316L and Ti6Al4V, to test the geometry loss factor. The mechanical performances of these specimens were compared to the ones of NiTi structures, pointing out good damping properties of the designed structure and the highest performances of the NiTi pseudoelastic effect. The NiTi damper was mechanically characterized by static and dynamic tests and with DSC and microscope observations. The experimental results were verified with numerical models and with some scaled steel specimens in which optical fibers were embedded. The realized structure presented good mechanical and damping properties. It was observed that the loss factor and the dissipated energy increased with the angles of the cells.

Keywords : additive manufacturing, damper, nitinol, pseudo elastic effect, selective laser melting, shape memory alloys
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