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Near Net Shape Forming of Light Weight Optic Structures for Space

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Space based optical systems require extremely lightweight and stiff materials that can survive the harsh conditions of launch. Traditionally, beryllium has been used for such applications, but at severe cost and health penalties. Hypereutectic Al-Si metallic glass is one such material that has properties *similar* to that of Be. Al-Si based glassy metal is lightweight, temperature resistant, wear-resistant and low CTE material with better mechanical properties. Moreover, it offers lower manufacturing costs and could be readily machined. Also, it has many potential applications in the aerospace and automotive industry that includes windshield frames and structures in high-speed aircraft and space vehicles, aircraft brakes, satellite mirrors, optical benches and gyroscopes, cylinder sleeve and piston rings for automobile engines. The low cost and energy efficient methods of near net shape forming using Vacuum Plasma Spraying (VPS) has been employed to fabricate this novel hypereutectic Al-Si alloy into useful shapes such as optical mirror for x-ray telescope. Spray forming has been carried out at different temperatures. HIP operation has also been performed as a post spray treatment. The spray-formed material has been characterized for its microstructure and mechanical properties as a function of processing variables. Vacuum plasma spraying of hypereutectic Al-Si powder produces a dense microstructure with fine (< 5 μm) and homogeneous distribution of Si particles in as-spray condition. Heat treatment has resulted in coarsening of Si particles to a large size up to 40 μm. Mechanical properties have also been correlated to the processing conditions by studying the fracture surface of the samples.