Energy Materials Analysis for Additive Manufacturing by Selective Laser Melting

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This research aimed to improve selective laser melting (SLM) of energy materials for thermoelectric power generation devices.Thermoelectric generators are solid state devices that offer the potential for waste heat recovery in combustion and heat process systems. These devices are currently being manufactured using bulk material processing with many integration and assembly steps, leading to decreased product efficiency and high manufacturing costs. Selective laser melting is an additive manufacturing technique, when combined with semiconductor powder offers a solution to these manufacturing challenges.

Using the imaging software FIJI and optical microscopy preliminary data on the morphology (circularity, convexity, particle size distribution) of bismuth telluride and magnesium silicide was established. This data showed that both circularity and convexity of these powders will need to be improved before being implemented into the SLM process. High energy ball milling will be tested with varying parameters, ball to powder ratio, grinding speed and duration as well as pause intervals. The centrifugal and high impact forces of this mill will be utilized to improve the powder morphology as well as the flowability. A powder spreading rig, which will be used to do SLM, was created. It was built through redesigning a 3D printer by reprogramming the microcontroller to guide the axial movements as well as an additional motor and microcontroller were added to guide the powder through the system.