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Applications of Additive Manufacturing Techniques in Making Energetic Materials

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ABSTRACT

Energetic materials are currently manufactured using methods such as casting, which can only produce certain geometries. Additive manufacturing enables more flexible fabrication and the potential for improved material consistency. Additive manufacturing has transformed many industries, but has only recently been applied to the manufacturing of energetic materials. This paper describes the development of two processes to apply additive manufacturing methods to energetic materials. Method one applies a fused deposition modelling approach (FDM). 5 µm aluminum powder and PVDF were mixed and made into filaments using a Filabot Original filament extruder. Energetic filaments were created composed of 90:10, 80:20, and 75:25 mixtures of PVDF:Al by mass. These filaments had reactive sections, but did not have consistent composition and could not sustain self-propagating reactions. The second method had the goal of mixing ammonium perchlorate (AP) into a curable polymer which solidifies under UV light. Powdered sugar was used in place of AP to simulate the viscosity while testing extrusion and printing capabilities. The powdered sugar and UV Cure mixture could be extruded using a syringe pump when the powdered sugar to UV Cure ratio was 3:1, but this mixture would not stick to the print bed. Both processes need refinement to produce functional energetic materials. This paper forms a foundation for further development of processes in which additive manufacturing can be safely used to produce energetic materials.

KEYWORDS

Additive manufacturing, energetic materials