3DPrinting of Magnetic Materials

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Abstract: 3D printing, additive manufacturing, has attracted significant attention recently as a technology that allows three dimensional shapes to be formed. Binder jet, Ink jet , printing are popular process that can compete favorably with injection molding and polymer bonding .Lasers provide a unique opportunity to heat small area of powder ,typically 20 to 40 microns, and the melt cools rapidly .The cooling rate is fast enough to form fine grained microstructure. In the case of hard magnetic materials this cooling rate allows the opportunity for the formation of nearly single domain grains .In the case of melt spun Neodymium iron boron ,selective lase meting(SLM) can be used to make bulk magnet fully dense bodies which otherwise not possible by melt spun ribbons. Ribbons need to be crushed and blended with polymers to shape magnet bodies or hot formed to make dense magnets. Soft magnetic materials such as Metglas also can formed by SLS. This paper explores the opportunity for 3Dprinting for magnetic materials.

Introduction:

This manuscript is a review which briefly describes 3Dprinting technologies and the vocabulary used. Application of 3Dprinting to make permanent magnets and soft magnetic materials is discussed.

3Dprinting is a general name given to number of technologies (1) as shown in Figure 1. ASTM classified the various terminology to the following seven categories: Binder jetting, Directed energy deposition, Material extrusion, Material jetting, Powder bed fusion, Sheet lamination, Vat photo polymerization. Directed energy deposition which includes laser deposition (LD), laser induced net shaping (LENS), electron beam melting, plasma arc melting as the AM technologies. Terminology across the world need to standardize but for now many names for a given technology.