Institut "Jožef Stefan" Ljubljana, Slovenija

TECHNOLOGY OFFER

FILAMENT WITH ORIENTED MAGNETIC PARTICLES FOR 3D PRINTING OF ANISOTROPIC MAGNETS

Fields of use
3D printing

Current state of technology
Under development / lab tested

Type of cooperation
Technical cooperation agreement

Intellectual property
Patent(s) applied for but not yet granted

Developed by
Jožef Stefan Institute

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Summary

A Slovenian research institute has developed an anisotropic polymer-bonded magnetic filament. The filament comprises magnetically anisotropic particles aligned relative to each other. The filament makes possible the manufacturing of arbitrarily shaped permanent magnets using 3D printing technology. Partners are sought amongst the magnet manufacturers for technical cooperation agreements to apply this technology to the 3D printing of permanent magnets.

Description of the invention

A Slovenian research institute has developed a novel filament for 3D printing of an anisotropic polymer-bonded magnet. The researchers have decades of experience in magnetic, ceramic and other materials.

Additive manufacturing has proven applicable to the field of manufacturing permanent magnets. 3D printing as the additive manufacturing technology for production has the advantage of being waste-free while offering infinite possibilities for producing complex shapes that could not be manufactured by other techniques. A polymer-bonded magnetic material is best suitable for 3D printing of magnets. The polymer serves as a bonding material between magnetic particles and is essential in defining geometry, and for mechanical stability. In 3D printing with present technology, the magnetic material in the filaments is magnetically isotropic. The novelty here is a filament with preferentially oriented anisotropic magnetic particles having superior magnetic properties.

Mixing of milled, magnetically anisotropic Nd-Fe-B particles, and a thermally softened polymer binder makes the filament. Extruding the filament, forming a wire, and exposing it to an external magnetic field aligns the magnetic particles in the preferred direction. The direction of alignment may be perpendicular, parallel or at a certain predefined angle relative to the long axis of the filament. The filament can also be segmented; the magnetisation axis can change along the length. This enables the fabrication of multicomponent magnets which can withstand higher demagnetization fields during operation. The anisotropic magnetic particles are aligned in the preferred direction before 3D printing, during the filament mass production in a factory. No further processing of the manufactured magnets requiring additional equipment at the customer site is needed.

The filament is typically provided in coils for storage. It is uncoiled and consumed during use. The handling is easy using the filament wire as a feedstock with a constant and regular input speed suitable for the 3D printing process. The filament is thermally labile such that it is softened for extrusion in a heated 3D printer head before solidifying shortly thereafter to retain its position at the printing coordinates.

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The investment is co-financed by the Republic of Slovenia and the European Union under the European Regional Development Fund.

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One of the potential final applications is in the automotive sector. Permanent magnets are one of the key parts of electric cars and their components. Better efficiency in comparison with magnets produced by extrusion may be given by the production of specific and complex shapes magnets. 3D printing is one of the most appropriate solutions for the production of such kinds of polymer-bonded magnets, however, there is still no 3D print technology for producing efficient anisotropic magnets.

Main Advantages

The filament for 3D printing proposed has the following advantages:

- 3D printing technology accommodates for arbitrarily shaped magnets.
- The anisotropy provides for the better magnetic properties of manufactured permanent magnets. Other available filaments for 3D printing are isotropic.
- The filament is pre-processed and magnetized in the factory before 3D printing.
- The filament can be stored and used later in manufacturing

Partner Sought

Partners are sought amongst the magnet manufacturing and 3D printing industry for technical cooperation agreements to test the filament for 3D printing an anisotropic polymer-bonded magnet.

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