# Fused Filament Fabrication for Metallic Parts

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## Abstract

Thermoplastic Fused Filament Fabrication (FFF) is one widely used additive manufacturing processes in the world. The main reasons of its popularity and use have been its reliability, safe and simple fabrication process, low cost, and the availability of a variety of building materials [1].

It is possible to produce metallic parts shaped by FFF through a shaping, debinding and sintering (sds) process [2]. In order to obtain metallic parts, thermoplastic filaments filled with a high concentration of metallic particles (> 50 %vol) are needed. Two main issues arise when adding a high concentration of particles to any polymer: increase of viscosity in the molten state and embrittlement of filaments in solid state (lower modulus and elongation at break).

To overcome these issues a tailored-made polymer binder system was compounded along with metallic particles at 55 %vol to make filaments that can be printed in a conventional FFF 3D printer. The apparent viscosity at the melting temperature of the compound and mechanical properties of printable filaments at room temperature were measured and compared to unprintable highly-filled filaments (Figure 1a).

After parts were printed, the thermoplastic binder system was removed by dissolution and thermal degradation, and finally a metallic part was obtained after sintering. Figure 1b shows the printed part and the sintered part produced by the newly developed material. One can conclude that it is possible to shape via FFF highly filled thermoplastic compounds that can be debinded and sintered for the production of metallic parts. The linear shrinkage from the printed to the sintered part is about 15%.

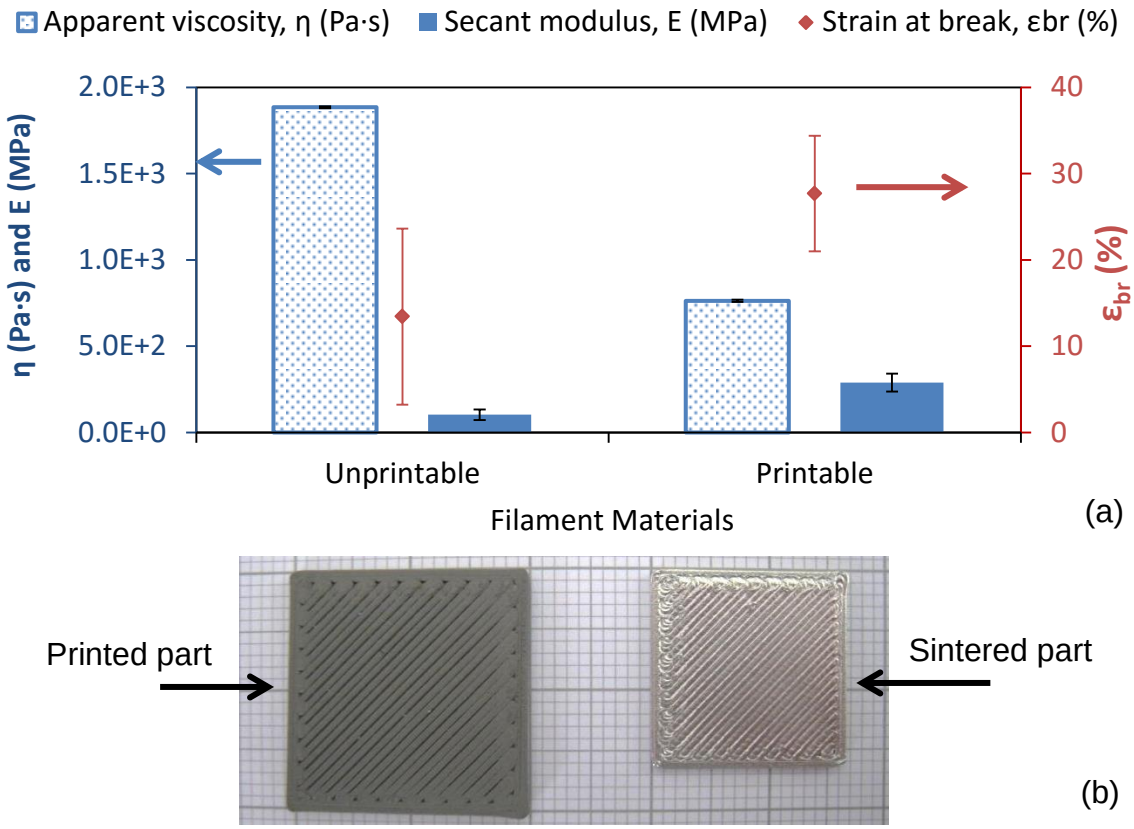


Figure 1: (a) Material properties of printable and unprintable materials; (b) printed and sintered parts produced by sds.

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## Literature

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