Impact of chain extension on the melt strength properties of 3d printed high-performance polyphtalamides using fused granulate fabrication (FGF) process

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The Fused Filament Fabrication (FFF) 3D printing is the most common and widespread additive manufacturing (AM) technique, but it requires the manufacturing of filaments. Fused Granular Fabrication (FGF), in which pellets are directly 3D printed, has become a promising technique for AM technology [1]. The prsent study is particularly focused on injection molding grade high performance polyphtalamides (PPAs) used in the automotive industry because of their excellent mechanical and thermal resistance properties. Two strategies were deployed to enhance the melt strength of PPAs in order to be suitable for the FGF process. The first was a partially reactive way where PA6T/6I copolymers continue to post-polymerize when they melt and the holding time in the extruder of the 3D printer was in-depth controled [2]. The collected PPA samples were further examined and demonstrated an increase in the molar mass and in the melt viscosity with time as measured by GPC and rheological tests, respectively. The second route was a reactive way where the reaction of the PPAs in the presence of 1, 3-Phenylene-Bis-2-Oxazoline (PBO) and 1,1'-Carbonyl-Bis-Caprolactam (CBC) as chain extender were performed using a twin-screw extruder [3]. The effect of concentration of PBO reacting with the carboxylic end groups and the CBC with the amine end groups on the melt processability behavior were investigated. A design of experiments was then employed to optimize the most important printing parameters based on Charpy impact, three-point bending and short-beam shear tests. The effectiveness of developped approaches to easily improve the melt strength of high performances semiaromatic copolyamides (PPAs) for direct pellet printing is thus demonstrated, allowing the possibility of transposing these finding to highly-filled glass fiber PPAs composites dedicated to aerospace industry.

Keywords: Polyphalamide, Chain extender**,** Fused Granular Fabrication, Reactive extrusion.

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