ADAPTING NEW MATERIALS FOR SLS: A CASE STUDY

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Selective laser sintering (SLS), a.k.a. powder bed fusion, is a unique 3D printing technology. Objects are created by selective laser irradiation of successive layers of powders of semi-crystalline thermoplastics or thermoplastic-elastomers in a heated chamber in order to sinter them together [1-2]. SLS has the potential to produce high quality parts for end-use, but industrial uptake has been slow. ~80% of the SLS market is dominated by polyamide 12 (PA 12), and alternatives remain scarce, especially when it comes to high melting point thermoplastics (T_m ~ 220- 260 °C). To facilitate the adoption of new materials formulations in the context of SLS printing, a rapid, reliable and efficient procedure is needed [3-4].

In this talk, the essential materials requirements for SLS will be introduced, with a focus on melt-processing characteristics and powder flow. This includes an investigation of both bulk (melting / crystallization behavior, melt rheology) and powder (particle morphology and flowability) properties. Then, the development of a new high melting point SLS formulation will be described. The selection of thermal characteristics and the optimization of powder characteristics (size, shape, flow properties) are related to SLS process conditions. A small but representative benchtop SLS CO_2 laser printer is used to assess the process window while consuming a limited quantity of materials (~ 50 g per layer), and the microstructure, tensile properties and fatigue behavior of printed parts are reviewed in comparison with those of two commercial references: PA 12, the most widely used SLS raw material (T_m ~ 185°C), and PA 6, a newcomer to SLS with an elevated melting point (T_m ~ 220°C). The work described here can be used as a guide for the effective screening and development of new materials for SLS.

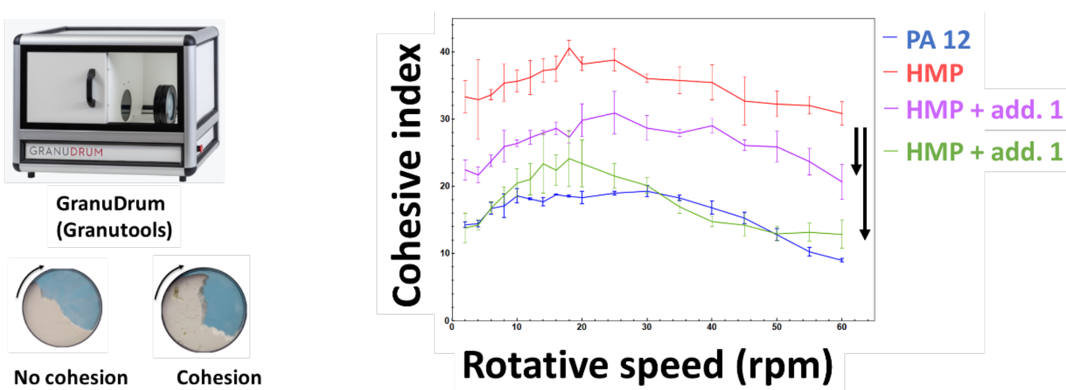

Figure 1 – (left) GranuDrum analyzes powder flowability in a rotating drum at different speeds (at ambient temperatures). (right) dynamic cohesive [5] index of the various powders with and without flowing additives.

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