Contribution ID: **218** Type: **Poster Presentation**

Tensile strengths of polyamide based 3D printed polymers in liquid nitrogen

Wednesday, 1 July 2015 09:00 (2 hours)

Advances in additive manufacturing technology have made 3D printing a viable solution for many industries, allowing for the manufacture of designs that could not be made through traditional subtractive methods. Applicability of additive manufacturing in cryogenic applications is hindered, however, by a lack of accurate material properties at cryogenic temperatures. Nylon, commonly used in cryogenic engineering applications, is available for printing using fused deposition modeling (FDM) and selective laser sintering (SLS). We selected 5 SLS (DuraForm® EX, DuraForm® HST, DuraForm® PA, PA 640-GSL, and PA 840-GSL) and 1 FDM (Nylon 12) nylon variants based on the bulk material properties and printed properties at room temperature. Tensile tests were performed on five samples of each material while immersed in liquid nitrogen at approximately 77 Kelvin. Samples were tested in XY and, where available, Z printing directions to determine influence on material properties. Results show typical SLS and FDM nylon ultimate strength retention at 77 K, when compared to (extruded or molded) nylon ultimate strength.

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Session Classification: M3PoB - Cryogenic Materials VI: Insulation

Track Classification: ICMC-14 - Cryogenic Materials Testing and Methods