Mohammad, Rahbari, MESc, "Application of ultrafine powder technology to improve the quality of Selective Laser Sintering (SLS) process", The University of Western Ontario, April 2005 (co-supervisor: M. Liu of NRC-IMTI) .

Abstract

Since its commercialization, Selective Laser Sintering (SLS) has become an essential Rapid Prototyping (RP) tool in reducing product design and development time. The surface roughness and dimensional accuracy of SLS manufactured parts are two major challenges to the process and both are strongly affected by the powder particle size. Two ultrafine powder systems were successfully used in a Sinterstation® 2000 to build parts. The first was a metallic-binder blend able to produce parts comparable with RapidSteel 2.0 (RS2) and the other a glass-filled nylon blend able to produce parts comparable to LNC 7000. Benchmark parts from the two materials were produced. The surface roughness, green and brown part density, green part strength, and dimensional accuracy of parts were measured. The ultrafine (~14μm) iron-polyamide 12 was able to achieve two to three times lower surface roughness than RapidSteel 2.0, while the ultrafine (~18μm) glass filled nylon powder system achieved about a 30% decrease in surface roughness from LNC 7000. The ultrafine iron-polymaide 12 powder used had a 2:1 metal-to-polymer size ratio, where as the desired minimal size ratio between the metal and the binder is 7:1. The low metal-to-binder size ratio in the ultrafine powder resulted in some of the shortcomings found in the parts formed from the powder system. To further substantiate claims made about the relationship between the metal to binder size ratio and part quality a 1045 steel powder with a metal to binder size ratio of 10:1 was used to build parts. The results support the claim that through the blending of the binder using the right particle size ratio, and mixing methods, a high quality part as good if not better than RapidSteel 2.0 could be built without the additional costs associated with coating the binder onto the metal. Furthermore, manipulating the binder concentration in the blend could control the porosity of parts produced, which is useful for some applications requiring porous metal parts. Future work is recommended to produce polyamide powder less that 2μm in size to serve as the binder for a 15μm metal powder achieving the minimal size ratio of 7:1 between the metal and binder required to ensure low shrinkage, and improved strength of parts produced from the ultrafine