Abstract

Selective Laser Sintering (SLS) is a sintering process in which shaped parts are built up layer by layer of powder material. A laser beam scans the powder layer, falling in the outline of each layers' CAD-image, and heats the selected powder to fuse it.

A model of selective laser sintering of crystalline polymers has been successfully developed which enables users to simulate density and size accuracy of a sintered part. Experimental works to measure material properties for supporting the model and to measure density and size accuracy of sintered parts manufactured by SLS have also been carried out. The model has been validated with the measured results. The predicted density and size accuracy of sintered parts created by the model have a good agreement with measurement. In this research, a polyamide powder (nylon-12, commercially known as Duraform polyamide) and a polyamide powder (nylon-11) mixed with glass particles (commercially known as Protoform composite) have been selected for study as these materials are crystalline polymers and have been extensively applied to manufacture functional parts using the SLS process.

There have been three key success in the development of the model. Firstly, including latent heat of melting of the powder in estimating process temperatures, using the temperature recovery method (TRM) to modify temperatures calculated by a finite element method (FEM) which ignored latent heat. Secondly, accounting for the crystallinity reduction of the polymers on melting, that influenced their sintering behaviour. And thirdly, considering the laser energy to be absorbed over a finite depth of the powder bed rather than at the surface.