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ANALYSIS OF THE SELECTIVE INFRARED SINTERING (SIS) PROCESS WITH A SPECIFICALLY DESIGNED LAB DEVICE

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Selective Infrared Sintering (SIS) is a new additive manufacturing process, in which the polymer powder particles are fused by IR irradiation. Carbon black is mixed with the polymer in order to enhance IR absorbance. An instrumented IR-sintering machine was designed and constructed in the lab, which allows to vary freely the main process parameters of SIS. This permits to analyze finely their influence on the properties of the sintered parts. The basic principles of SIS are the same as those of rapid prototyping techniques dealing with polymer powders: the object is built layer by layer in the vertical direction by fusing particles over appropriate areas. The difference lies in the irradiation mode. Here, a mask, i.e. the negative image of the section to be sintered, is placed above the build tank surface. The whole area delimited by the mask is then irradiated by a single flash of the infrared source, so that all powder particles in the section are (partially or totally) melted simultaneously.. This research was aimed at determining the effects of variations of process parameters on the microstructure and the mechanical properties of parts produced by SIS. First, the main process variables (preheating temperature, source power, flash duration and layer thickness) were systematically varied, and tensile and impact test samples were sintered with these different sets of variables. Then, microstructures were studied by scanning electron microscopy. The characterisation of the thermal properties was carried out by DSC. Densities, tensile and impact properties were measured. Beyond the analysis of the influence of any single process parameter, the cumulative energy received by a material element in the sintered part has to be taken into account to explain the morphologies, the physico-chemical and mechanical properties.