Three-Dimensional Slurry Printing Technology in Ceramic and Metal Application

Cho-Pei Jiang[1,2], M Fahrur Rozy Hentihu[2,3] and Tzu-Yi Lei[2,3]

[1]Department of Mechanical Engineering, National Taipei University of Technology, Taipei 10608, Taiwan

[2]Graduate Institute of Manufacturing Technology, National Taipei University of Technology, Taipei 10608, Taiwan

[3]Additive Manufacturing Center for Mass Customized Production, National Taipei University of Technology, Taipei 10608, Taiwan

*Corresponding author: +886-2771-2171#4833 and E-mail: jcp@ntut.edu.tw

Abstract

Vat Photopolymerization is one of additive manufacturing and also known as photo-curable three-dimensional printing technology. It uses light energy with the proper wavelength to expose on the liquid photo-curable resin inducing the photopolymerization process and resulting in solidification layer-by-layer. The building method is classified into two ways: free-surface and constrained-surface. The advantage and disadvantage of both methods are described and analyzed according to the different material property and requirement. The basic composition for photo-curable resin consists of photo-initiator and monomer. Adding powder into photo-curable resin makes the photo-curable slurry. Literatures report that high density powder such as zirconia oxide or Inconel 718 is suitable for free-surface building method because of poor suspension. However, the volume percentage in the slurry is less than 50% causing the higher shrinkage ratio and inaccuracy after sintering process. The coupling agent may increase the suspension of powder in slurry but experimental result shows that it still cannot improve the success rate in the constrained-surface building method. Therefore, this study proposes a combination method to overcome the difficulty of making high density ceramic or metal part as shown in Fig. 1. In addition, the sintering process is a key factor to obtain the high dense part with no crack occurrence and desirable microstructure. The optimized sintering parameters for zirconia oxide and Inconel 718 are also introduced.

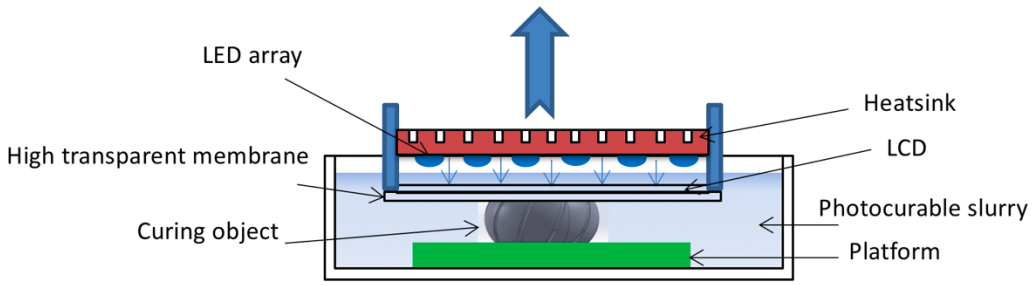

Fig. 1 The principle of the proposed novel 3D printer using the upper and lower surface constrained method.