

3D printing of glasses by digital light processing, binder jetting, fused deposition modelling & direct melt printing

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3D printing of glasses has been the area of interest for the past few years because of its ability to produce glasses in complicated shapes which cannot be achieved by the traditional glass manufacturing techniques. Glass 3D printing is generally conducted by either heating it to its liquid state or by sintering of glass particles. Fused deposition modelling (FDM) and direct melt printing (DMP) techniques have been used to 3D print a glass by heating a filament [1] or directly by melting a batch in a kiln [2]. Digital light processing (DLP) and direct ink writing (DIW) have also been used to synthesize 3D printed parts by sintering of Nano sized glass particles [3, 4]. Binder jetting (BJ) is another 3D printing technique which requires sintering to get a transparent glass. 3D printing of glasses involving the process of sintering has been mostly limited to silica based solutions because of its high thermal stability against crystallization.

In this work, much focus has been given to 3D printing of fluorophosphate (FP) glass using FDM, DMP, DLP and BJ 3D printing technologies. The results obtained by 3D printing of FP glass using each technique will be compared. DSC has been used to determine the drying and debinding reaction of the organic materials used during DLP and BJ processes and the crystallization temperature of the 3D printed objects. In FDM and DMP the viscosity-temperature dependence of the FP glass is important to estimate the nozzle temperature for the 3D printing process. In all the techniques we applied so far, bubbles were inevitable in the final 3D printed glass objects, which affected their transmittance.

References

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