3D fine scale ceramic components formed by ink-jet prototyping process

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Numerous solid freeform fabrication (SFF) techniques to form ceramic parts have been developed during the last decade. The prototyping techniques developed up to now for ceramic parts such as the stereolithography, the fused deposition modeling and the selective laser sintering are characterized by definition around 150µm, and don't allow to deposit different materials on the same layer. In comparison, ink-jet printing prototyping process opens the way to the development of multifunctional 3D fine scale ceramic parts.

In fact, ink-jet printing prototyping process consists in the deposition of ceramic system micro-droplets (a few pl) ejected via nozzles to build the successive layers of the 3D structures. Consequently, by adjustment of the aperture of the printing head and the control of the spreading phenomenon of the droplet, one can expect to reach a standard definition around 50µm which could finally decrease to 10µm.

Thanks to its high flexibility in terms of design because of its capability to deposit different materials with a high definition, this technique may be applied in particular to the production of sophisticated microelectronic devices integrating metallic connection network (packaging, micro-actuators or sensors...).

The investigations carried out in the SPCTS Laboratory to develop multimaterial 3D fine scale parts by ink-jet printing process are mainly focused on the optimization of the process through :

-the adjustment of the fluid properties of the organic/ceramic suspensions in terms of viscosity and surface tension via the formulation of the suspensions and the driving parameters of the printing heads, in order to have consistent droplet formation,

-the study of the dependence of the droplet size and velocity with the same factors by capturing stroboscopically backlit images using CCD camera system,

-the characterization of the deposits obtained after droplet impact according variable ejection conditions.

Finally, trials of 3D ceramic ink-jet printing have been achieved from a 10 vol% PZT loaded suspension to obtain a PZT pillar array corresponding to the skeleton of 1-3 ceramic polymer composite for imaging probes. The green structure exhibits a definition equal to 90µm.