

Ceramic/metal multi-material parts by 3D extrusion printing and sintering: experiments and FEM modeling of the sintering stage.

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Sintering-assisted 3D extrusion is an additive manufacturing process that enables the rapid, low-cost production of parts with complex geometries. The process involves 3D extrusion of a polymer (binder) filled to around 50% by volume with a metal or ceramic powder. After a debinding step, sintering is a critical stage during which shrinkage, deformation and cracking can occur. These phenomena are particularly important in the case of slender structures (creep under own weight) or multi-material parts (sintering kinetics and thermal expansion differentials). A comprehensive approach combining modeling and experimentation has been used to predict the sintering behavior of YSZ/Steel 316L bi-materials produced by 3D extrusion.

For this purpose, these deformations were described as the result of different contributions linked to reversible (elastic deformations, thermal expansion) and irreversible (densification, viscoplasticity) phenomena. Initial dilatometry tests enabled us to determine an Arrhenius-type sintering behavior law for each material. Then, dilatometry tests under load cycle were carried out to determine a viscous behavior law. A finite element model was then implemented and validated for the sintering of slender single-material part by comparison with optical dilatometry monitoring.

The model was then applied to the sintering of multi-material parts (bi-layers), and optical dilatometry was used to monitor the deformation of bi-materials in temperature in real time.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

Author: Ms NOUGUIER, Elsa (Laboratory SIMaP - Grenoble INP)

Co-authors: Dr JAUFFRÈS, David (Laboratory SIMaP - Grenoble INP); Prof. MISSIAEN, Jean-Michel (Laboratory SIMaP - Grenoble INP); Dr COFFIGNIEZ, Marion (Laboratory SIMaP - Grenoble INP)

Presenter: Ms NOUGUIER, Elsa (Laboratory SIMaP - Grenoble INP)

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