

2<sup>nd</sup> International Conference on

# 3D Printing Technology and Innovations

March 19-20, 2018 | London, UK



## *Gremillard Laurent*

*MATEIS (UMR CNRS 5510), France*

### **Robocasting of dense ceramic parts**

Additive manufacturing of ceramic has known a large expansion over the past few years, mostly for its ability for creating 3D complex ceramic bodies with controlled porosity. Robocasting, or direct-ink writing, is one of the techniques available for ceramic additive manufacturing. It implies the extrusion through a nozzle of a self-setting paste in the shape of a filament to create the desired shape, layer by layer. One of the great interests of this technique is the possibility to fabricate multimaterials in one single printing step, using multiple pastes. This include both porous, architecture pieces and dense bodies. However, shaping dense bodies (from either single or multiple inks) is still a challenge not completely met by additive manufacturing in general and direct ink writing in particular, since the properties obtained by conventional processing have not yet been successfully reproduced. The aim of this presentation is to demonstrate the correlation between printing parameters (nozzle diameter, inter-filaments distance, printing velocity, environment), paste fabrication (solid loading, binder, solvent, mixing, degassing, rheology), thermal treatments (drying, debinding), defects distribution and mechanical properties in final sintered bodies. We'll show that printing precision, pattern design, layer-to-layer spacing and substrate adhesion play a critical role on the quality of the final piece, in a way that is far more important for ceramics than for polymers and metals. An optimization of all steps of the robocasting process enables the fabrication of dense high-strength materials with mechanical properties similar to those obtained by conventional processing.

### **Biography**

Gremillard Laurent has completed his Engineering Degree and PhD from INSA-Lyon, France. After a 2-years Postdoctoral Fellowship at Lawrence Berkeley National Laboratory, California, USA he was appointed a Scientist at CNRS (France) in the Materials Science and Engineering Laboratory (MATEIS) at INSA-Lyon, France. He is now Senior Researcher at CNRS, and Head of the Biological Interactions and Biomaterials Team of MATEIS. He is mostly known for his work on zirconia as a biomaterial. His research interest are: zirconia bioceramics, 3D printing by robocasting. He has published more than 65 papers in reputed peer-reviewed, international journals and has been serving as a Symposium Organiser of ESB 2016 and EUROMAT 2017.

[Laurent.gremillard@insa-lyon.fr](mailto:Laurent.gremillard@insa-lyon.fr)

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