

## Research Topic 23 for the ParisTech/CSC PhD Program

FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:

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**Subfield: Mechanical Engineering and Manufacturing, Materials Science**

**Arts et Métiers ParisTech**

**Hybrid manufacturing process of metal cellular structures using 3D printing of sand molds  
and low-pressure casting technologies**

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### Short description of research topics for a PhD:

Additive Manufacturing (AM) has accelerated the manufacturing processes with great extent. The main advantage of the AM is the minimum tooling required along with the high buy-to-fly ratio due to the addition of layers which waste less raw material in contrary to removing the material from a block to produce a part. Consequently, the costs of the fabricated parts and lead-time have significantly declined with enhanced buy-to-fly ratio. Similarly in the area of metal shape casting, AM is playing its pivotal role, for instance; in the sand casting sacrificial sand molds are fabricated with the 3DP ink-jet technology which eliminates the need of skilled workforce for pattern making. Hence, pattern making is the most challenging task in the shape casting of alloys which is expensive, restricted to relatively simple shapes and time consuming keeping in consideration the design rules of pattern making. Replacement of pattern with 3DP sand molds and cores also shrinks the size of shop floor required because 3DP machines are compact and occupy less space. Moreover, to print complicated sand molds having embedded cooling channels, risers, runners and gates is one of the main entices of this technology. In addition, design revisions and optimization of the mold; gating, runner, feeder system and casting parameters can be performed quickly and easily with less cost as compared to the conventional pattern making approach. Also, this technology is very suitable for the smaller lot production in shape casting as in prototyping of the new part design validation in aerospace and automobile sectors. This PhD work will focus on the use of the 3DP technology and low-pressure casting to produce lightweight cellular materials with functional designed mesostructure.

### Required background of the student:

1. Candidates should have a master degree in materials science or mechanical engineering;
2. A background in additive manufacturing, laser materials processing, and topology optimization will be a clear advantage;
3. Candidates should be able to work in a multidisciplinary environment and be fluent in English (both oral and written).