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Master student traineeship proposal

Title: *Conception of an experimental setup for multi-material hydrogel infusion additive manufacturing*

Abstract:

This project is at the intersection of Additive Manufacturing (AM) and 3D printing. Both are manufacturing processes where components are built layer-by-layer, AM generally refers to metals, whereas 3D printing is typically associated with polymers. For the comparable geometric resolution and sample size, 3D printing technologies are much more advanced and cheaper.

The principle of Hydrogel Infused Additive Manufacturing (HIAM) is to use 3D printing to create a hydrogel with very accurate geometry features, the hydrogel is then infused with a metal nitrate solution (usually nitrates, such as copper or iron nitrates), which, after heat treatment, ic converted into a metallic component [1]. Beyond the geometric advantages, HIAM also enables efficient combination of multiple materials compared to other techniques such as direct energy deposition AM [2]. The goal of this project is to develop an experimental setup capable of infusing multiple metallic nitrates into a single hydrogel. Figure 1 schematically illustrates what it would look like for a 2-component infusion (before (a) and after (b) infusion in the hydrogel).

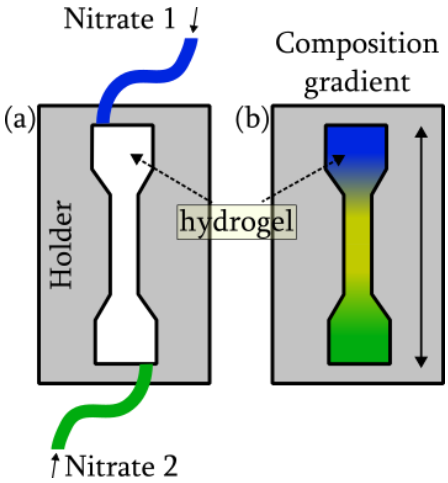

Figure 1: Schematics of (a) the hydrogel before infusion, (b) the hydrogel after infusion

This project is mainly experimental with an iterative experimental approach. The first phase will focus on CAD (SolidWorks) to design the setup (holder and hydrogel shapes), followed by experimental testing of different solutions.

References:

[1] Saccone, Max A., et al. "Additive manufacturing of micro-architected metals via hydrogel infusion." *Nature* 612.7941 (2022): 685-690.

[2] Schneider-Maunoury, Catherine, et al. "Functionally graded Ti6Al4V-Mo alloy manufactured with DED-CLAD® process." *Additive Manufacturing* 17 (2017): 55-66.

Scientist in charge: Loïc Jegou

Beamline(s)/Host Group: ID11

Traineeship supervisor(s): Loïc Jegou

Access to Instruments/labs/computing/software: ID11 labs, ESRF labs, Science building (ILL), SolidWorks

Starting date and Duration: March (6 months)

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