Protective coating development for SOCs

Master Project (30 ECTS) / Semester Project (10 ECTS)

Administrative

Supervision: Samaneh Daviran, Prof. J. Van Herle
Contact: samaneh.daviran@epfl.ch
Location: Sion (travel allowance offered)
Remarks: If interested, please send your CV, with a short motivation letter, to Samaneh Daviran

Project description:

Inkjet printing (IJP), one of the additive manufacturing techniques, has a long history in graphic printing. Recently, IJP has attracted interest for a wider range of applications due to its high resolution, simplicity, contactless process, and low material waste. IJP relies on droplet generation from micron-sized nozzles. The bottleneck of inkjet printing is avoiding nozzle blockage due to particle agglomeration. Therefore, stable, well-dispersed, and agglomerate-free particle inks are required for IJP.

In our previous study [1], experiments with IJP utilized water-based inks, improved with additional components to optimize printing properties. While water-based inks offer certain advantages, they also introduce complexities for IJP applications. The use of multi-liquid components can create hydrodynamic challenges during jetting. So, the alternative base liquids could be such as hydrocarbon- or phase-change-based inks, which may offer different hydrodynamic properties. Therefore, the goal of this study is to formulate a stable and suitable non-aqueous colloid containing ceramic powders for inkjet printing.

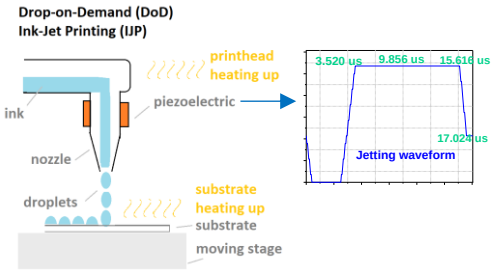

Figure 1. Schematic of a Drop-on-Demand (DoD) inkjet printing (IJP)

Your tasks:

The powder is available from a supplier and requires thorough characterization using XRD, SEM, XPS, PSD, and TGA. The appropriate base liquid and dispersant must be selected to achieve a stable and suitable ink. To assess these properties, sedimentation tests, rheology, and surface tension of the ink should be characterized. The printable ink will be deposited on interconnect steel substrates. Printing parameters such as jetting frequency, droplet formation, drop spacing, and applied waveform should be optimized. A post-treatment is required to vaporize the ink liquid and achieve uniform, dense, and good surface coverage of the printed layer. The morphology and crystalline structure of the deposited coating will be analyzed.

The project begins with a literature review on different types of base liquids for the colloid, as well as the additives/polymers that can be used to achieve a stable colloid. The student will be supervised and receive training in the colloidal preparation process, printing, and the required characterization techniques.

Reference

[1] S. Daviran, “Spinel Protective Coatings for Solid Oxide Cells (SOCs) Interconnects (ICs)”, PhD Thesis, Group of Energy Materials (GEM), EPFL, 2024.