Development of inkjet-printed conductive tracks for textile electronic circuits

Environment

The Flexible Electronics Department (FEL) in Gardanne is part of the Provence Microelectronics Centre (CMP), one of the five research centers of Mines Saint-Etienne, itself a School of the Institut Mines Telecom. Its skills include flexible and stretchable electronics, heterogeneous integration, energy harvesting and flexible batteries. The department's research is motivated by developping autonomous and communicating electronic systems for the design of sensitive interfaces, electronic skin, medical devices, etc.

Context & Objectives

Electronic textiles or smart textiles are advanced textiles that include electronic functionality ranging from conductive tracks to sensing/actuating, communications, microprocessing and power management. The market for e-textiles is projected to reach $2 billion by 2029. E-textiles provide a platform that should enable an imperceptible deployment of sensors and actuators, with many areas of applications (military, safety clothing, sport, health).
One key issue remains the development of reliable conductive tracks on textile. These tracks must have appropriate electrical conductivity, lateral resolution and withstand mechanical stresses and washing constraints. In addition, they must allow the interconnection of various electronic components such as passive components, sensors, microprocessors, batteries, … Among the different techniques that can be used, inkjet printing is probably the most interesting because it allows a small amount of conductive ink to be deposited in a given location without the need to make an expensive mask. But the viscosity of the ink must be very low (approximately 10 Cps) which induces undesirable spreading phenomena both in the plane and through the textile, degrading the lateral resolution and the electrical conductivity. To minimize this spreading effect, the textile surface must be modified either by chemical surface treatment or by depositing an interface layer. In addition, different inks can also be evaluated.
In this context, the overall objective of this master's internship is to develop and characterize reliable conductive tracks on textiles with appropriate conductivity, lateral resolution and mechanical robustness using the inkjet printing technique. To achieve these objectives, different fabrics and surface treatments will be evaluated using initially a commercial ink with silver nanoparticles but the evaluation of other types of conductive inks is envisioned. The interconnection of discrete components on these tracks using both bonding and soldering processes will also be investigated.

Description :

The master student will first carry out a bibliographic study in order to build a state of the art on electronic circuits on textiles with a particular focus on the inkjet printing technique. Through this study, the different factors that affect the lateral resolution, conductivity and reliability of inkjet printed tracks should be highlighted.
At the same time, the intern will be trained on the different equipments needed (goniometer, surface treatments, inkjet printer, electrical and mechanical tests, …).
Then, the inkjet printing of conductive tracks on fabrics with different bulk and surface properties will be performed and characterized through electrical and mechanical tests.
Finally the interconnection of discrete components on these tracks using both bonding and soldering processes will also be investigated.

The master fellow should have a background in materials science, physics or microelectronics and have autonomy and good communication skills

To apply, please send your CV and a cover letter to

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Starting date: from February to april 2022

Duration: 6 month

Salary : ≃ 550 euros

Location : Campus Georges Charpak Provence,
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