Université Lille Nord de France
Pôle de Recherche et d'Enseignement Supérieur

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Titre Thèse	Flexible and wearable electronics using 1D-2D materials	
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Résumé du sujet :

Printed electronics is a set of printing methods for depositing electronic materials (insulating, conducting, and semiconducting) onto arbitrary substrates to create a wide range of devices, such as organic thin film transistors (OTFTs), light-emitting devices (LEDs), diodes, detectors, etc. Among different printed techniques, inkjet printed approach is a suitable and low cost (avoid waste of material) technology for flexible electronics, when high resolution is the main criteria. However, improving the quality and the reliability of printed patterns in terms of geometry and resolution remain challenging. It means, the printed pattern dimensions must be as close as possible to the designed value, and the pattern defects such as holes and the rough pattern boundary must be well controlled. The objectives of this study are :

1)- Develop original large scale / Low cost fabrication methods with high reliability
Here, we will mainly consider inkjet printed approach as the most deposition technique. Attention will be paid on devices requiring high resolution, with a good reliability, and lower loss. For this objective, (i) the design and fabrication of passive devices requiring high resolution such as low impedance transmission lines, filters, antennas will be made. Similarly, (ii) the design and fabrication of active devices using 2D materials with short drain-source contacts (around µm) will be explored. 2D materials such as CVD MoS_2 and WSe_2 will be used as active layers transferred from rigid substrates, or solution processed materials as CNTs, which have demonstrated to provide good high on/off ratios as well as large mobilities. Dielectrics as parylene or Al_2O_3 will be taken into account, which have the potentials to be explored at high frequencies.

2)- Demonstrate functional fast and flexible prototype circuits combining several types of building blocks of active and passive devices.
We consider that if the first part is succesfull, the project will gather the necessary elements to climb from devices to circuits and functions. Indeed, by extracting electrical circuit of active and passives devices, il will be possible to design and fabricate with fully printed technology digital and analogue circuits with different functionalities. Conventional demonstrators will be first targeted : complemetary inverters, oscillators, amplifiers. They do not constitute ulimate targets, but represent natural milestones in the project roadmap. The choice of original functions will be defined during the project.

3)- Benchmark the functionality for applications in several domains of these circuits against other technologies. After characterization of electronic circuits and systems, we will envision the decisive progresses in the field of IoT and potentially in the field of sensors.

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