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Press release

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Innovative and Transparent Radio-Frequency devices based on Nanocelluloses-Silver Nanowires hybrid system

On January 20, 2022, Maxime Wawrzyniak defended a doctoral thesis from Université Grenoble Alpes prepared at IMEP LAHC under the supervision of Professor Tan Phu Vuong (Grenoble INP-Phelma / IMEP LAHC) and at LGP2 under the supervision of Julien Bras, HDR Lecturer (Grenoble INP-Pagora / LGP2) and the co-supervision of Aurore Denneulin, Lecturer (Grenoble INP-Pagora / LGP2). He presented the results of his research entitled *Development of Innovative and Transparent Radio-Frequency devices based on Nanocelluloses-Silver Nanowires hybrid system*.

Telecommunications systems have evolved significantly in recent years to meet the requirements of the Internet of Things, smart buildings or packaging. These new devices require flexibility and transparency to facilitate their integration into every-day-life objects. Printed electronics, which implement functional inks by printing processes, make radiofrequency systems flexible and efficient. The recent development of transparent and conductive inks opens up new way of design and integration.

This thesis focuses on the development of passive and transparent radio frequency (RF) systems using printing processes such as screen printing. To achieve this objective, three strategies are proposed.

The first strategy consists in opening the design of the antenna (mesh) in order to let the light pass through the device. The mesh geometries of screen-printed dipole antennas were examined. A second study was carried out on the influence of the mesh opening on the optical and RF properties of Coplanar Waveguide (CPW) antennas.

The second strategy concerns the development of transparent conductive inks. Current commercial inks are too weakly electrically conductive to produce effective RF devices. When organized as a network, silver nanowires exhibit excellent conduction and transparency properties. According to recent work, placed in synergy with nanocellulose, a biosourced and renewable polymer, they make it possible to obtain promising optical and electrical properties in printed thin layers by screen-printing. The optimization of the formulation has made it possible to obtain a new conductive ink compatible with RF specifications with a surface resistance of 2 Ω.sq-1 for a transparency of 72 %.

Finally, the third strategy is based on the combination of the two previous strategies.
These promising results pave the way towards the integration of transparent RF devices for telecommunication, smart packaging or smart buildings.

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