



**Camille DELFAUT**

Ph.D. thesis (2018-2021)  
LGP2 (N. Reverdy-Bruas, D. Curtil)  
IMEP-LaHC (T-P. Vuong)

## 3D printed electronic for Molded Interconnected Devices (MID) dedicated to internet of Things applications

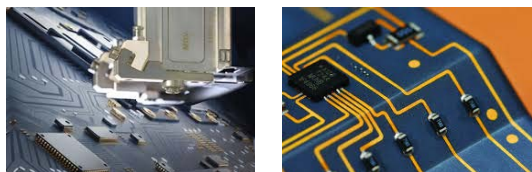
*Impression robotique 3D de circuits plastroniques pour des applications Internet des Objets*

### Context

#### Application

- IoT (Internet of Things)
- Radio frequency area
- Additive functionalities

#### Advantages of printed electronics on thermoplastics



- 3D or complex surface
- From customization to mass production
- Additive manufacturing

#### New market

- Automotive
- IoT
- Telecommunications
- Health

In collaboration with

Funded by  
**Smart**

FONDATION  
Grenoble INP

IMEP-LAHC

Schneider  
Electric

### Methods

#### Printing processes

- Dispensing
- Jetting
- 6 and 4 axis robot
- Functional conductive ink



#### Development of prototypes

- LoRa antenna
- RFID Tag
- Sensors
- Circuits

#### From 2D to 3D devices

- Simulations
- Influence of printing parameters
- Influence of curing
- Characterisation and performances

#### Surface characterisation

- Morphological studies : Alicona, optical profilometer, adhesion test

#### Electrical and radiofrequency characterisation

- Four probes
- Anechoic chamber
- Network analyser (VNA)



### Results

#### Process characterisation:

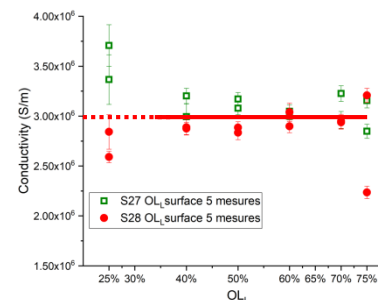
##### Geometry

- Drops geometry
- Lines geometry



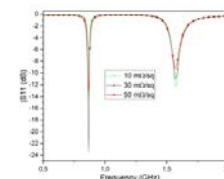
##### Electric

- Lines conductivity as a function of overlap



#### Development of LoRa antenna

Integration of LoRa antenna on the case for saving space on the device PCB



Antenna printed within present project

\*C. Delfaut, T.-P. Vuong, N. Reverdy-Bruas, D. Curtil, C. Venet, In 2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, Atlanta 2019

Photo

Prénom NOM

Ph.D. thesis (2013-2016)

LGP2 (X. Yyyyy; Z. Ffff)

LRP (A. Bbbb; C. Vvvv)

# Study of a very smooth paper for smart applications and mechanical properties

*Etude d'une nouvelle séquence de blanchiment à faible impact environnemental*

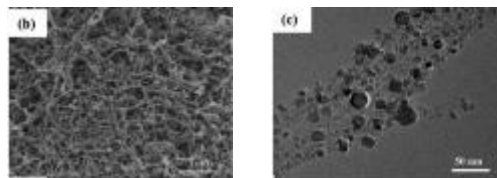
## Context

### Chlorine dioxide bleaching

*Sub-title if necessary*

- 75% of the world's bleached pulp
- Most used and efficient one
- Pollutant with organic chlorinated compounds

### Advantages of CF/AM composites as electrodes in Li-ion batteries



- Great porosity and surface area
- Electronic conductivity
- Mechanical properties

Texte, texte et texte. Texte, texte et texte. Texte, texte et texte. Texte, texte et texte. Texte, texte et texte.

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In collaboration with Virginia Tech

## Methods

### Printing processes

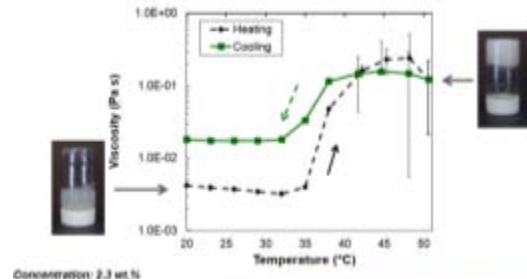
*Screen-printing*

Speed: medium  
Resolution  $\approx 100 \mu\text{m}$   
Inexpensive inks  
Thickness : 2 – 100  $\mu\text{m}$



### CNC as additive material:

- Rheological** behaviours of CNC hydrogels



*Responsive PNIPAAm-NCC – Cranston, Tappi 2013*

- Cosmetic & biomedical gel suspensions
- Texte
- Texte

Texte, texte, texte, texte...

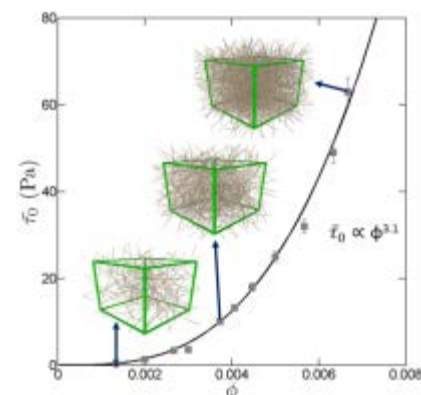
## Results

### Yellowing study

Carbonyl groups are the main contributors to the alkali yellowing. A P stage destroys the CO and stabilizes the brightness.

### Rheology of NFC water suspensions

- The USV shows complex flow phenomena



*Slight lignin depolymerization*

### Conferences:

Perrin, J & al. (2014). *International pulp bleaching conference*. Grenoble.

Perrin, J & al. (2014). *Tappi PanPacific Conference*. Taipei.

### Publications:

Perrin, J & al . *BioResources*, 9(1), 7299–7310