Zelda MONTEIL-OCHS
Ph.D. thesis (2023-2026)
LGP2 (D. Beneventi)
STPE - CEA Liten (G. Furia ;
JF. Blachot ; M. Heitzmann)
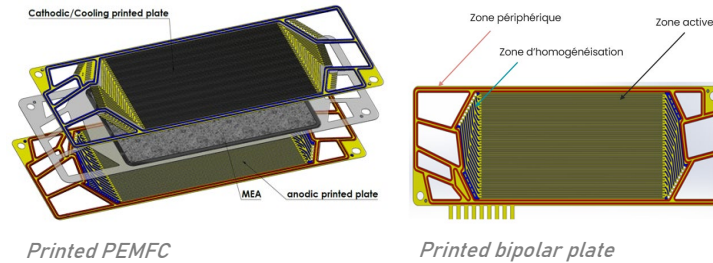
Development of conductive biosourced composites for PEMFC fuel cells

Développement de composites biosourcés conducteurs pour les cellules PEMFC

FunPrint

Context

Printed PEMFC developed by CEA

Objectives: offer a sustainable, ecological and economical technology.

Printed PEMFC

Printed bipolar plate

Advantages of printing: lightweight, compact, roll to roll industrialization and flexible in implementation

Printed bipolar plates in PEMFC cells

Printing of fluidic channels to distribute gases and cooling, conduct electrons, water management and mechanical strength of the cell

Carbon composites printed on carbon substrates But based on harmful fluoropolymer incompatible with potential European legislation

Funded by:

Objectives

**Replacing the fluoropolymer in the composite with a biobased polymer**
To obtain a composite that meets specifications

Composite specifications

- Composition: biobased binder + carbon fillers
- Compressive electrical conductivity, ICR < 10 mΩ.cm² under 1 MPa
- Resistant to heat (80 °C), water/moisture and acids (pH = 3)

Printing processes: Screen-printing

Resolution: 50 µm
Thickness: 200 µm

Screen-printing principle
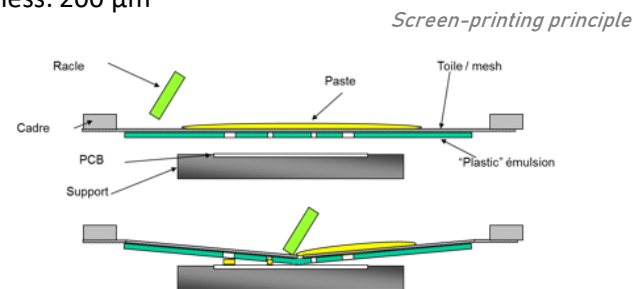
Formulate inks compatible with the screen-printing process to shape the composite

Methods

Two types of composites

- Composites with discontinuous polymer matrix, cured (90-130°C)
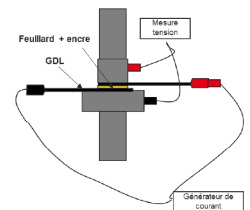- Composites with continuous polymer matrix, cured and carbonization (850°C)

Find the optimum ink composition to obtain a composite that meets specifications

Ink characterization

- Rheological behavior → Rheometer
- Stability, homogeneity, aggregation → SEM

Printed composite characterization

- Structural properties → SEM, density measure, permeability measure
- Electrical properties → ICR test
- Thermo-mechanical properties → mechanical test in compression, DSC, TGA, DMA, etc.
- Surface properties → contact angle
- Resistance in stacked environment → ageing test

ICR test principle