THE SMART COMPOSITES PLATFORM TOWARDS ADVANCED FUNCTIONALIZATION OF SMART LIGHTWEIGHT COMPONENTS FOR AUTOMOTIVE AND AERONAUTICS
IPC, established December 1st 2015, is the French Technical Centre for Innovation and Expertise in support of Industry.

Opened to industrials, IPC takes part in the setup of partnerships and helps to create synergies between actors of the plastics and composites branches.

OUR OBJECTIVES
Improving the competitiveness of the industry through innovation
Giving access to latest technological means for industrials.

EXPERTISE RESEARCH & DEVELOPMENT

Our activities
- R&D
- Services
- Collective actions
- Training

Our competencies
- Materials
- Design & simulation
- Processes & tools
- Smart Hybrids
INNOVATION PLASTURGIE COMPOSITES

IPC is established in seven locations in France.
INNOVATION PLASTURGIE COMPOSITES

130 employees (researchers, engineers, technicians): multi-competencies teams

Market share:
- 22% VARIOUS
- 5% ELECTRONICS
- 8% PACKAGING
- 15% MEDICAL
- 25% AUTOMOTIVE
- 25% AEROSPACE DEFENSE

Annual sales:
- 2010: 5.9M €
- 2011: 6.3M €
- 2012: 6.7M €
- 2013: 8.2M €
- 2014: 8.2M €
- 2015: 9M €
- 2016: 10M €
- 2017: 12M €

Collective actions setting-up

Services for companies:
- 40%

Research & Development (private R&D or collaborative projects):
- 60%

Our certifications:
- CIR Agréé Crédit Impôt Recherche (CIR)
- SGS Certifié ISO 9001 v2008
- COFRAC ISO 17025

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POLYMER-BASED STRUCTURAL LIGHTWEIGHT COMPONENTS: OPPORTUNITIES & STAKES
Towards advanced functionalization of lightweight components

- Parts’ integration
  - Take advantage of moulding possibilities of composites and plastics parts
  - Replace several metallic parts by one composite part

- For
  - Lightweighting: Thanks to specific mechanical properties
  - Cost reduction: By limiting the number of assembly steps

- Answering the demand for lightweight and high-performance products requires high-level skills and facilities throughout the value chain

- NEW MARKETS’ NEEDS AND DEVELOPMENT
  - Multi-material integration
  - New functions’ integration
Polymer-based structural parts

Production of semi-structural and structural parts at high rates
  - Combine mechanical resistance and design freedom
  - Decrease cycle time
  - Net-shape processing

Processing issues
  - Temperature management throughout cycle
  - Composite handling (gripper/mould)
  - Mould kinematics for complex shape forming

“STIICPA” Project
Polymer-based structural parts

- « Hybrid » carbody inner part
  - New design using organosheet overmoulding
  - 40% mass saving

Main innovations
- Large and thin part
- Local reinforcement
- No composite loss
Polymer-based structural parts

Process flow

1. Mold opened
2. Organosheet in the mold
3. Mold closed
4. Polymer injected
5. Cooling
6. Part ejection
7. Final part

Infra-red oven with multiple setup (32 areas)

1600 T injection machine equipped with a 6-axis robot
Polymer-based structural parts

COMPOSTAMP project
Economical stakes

🥦 Economical analysis
- Composites solutions cannot meet economical balance vs metals in some applications
- Need for further developments in products’ design
- Intense R&D effort to sink costs (materials, processes, simulation)

🥦 Still, cost objectives can only be met with further integration → electronical + mechanical

➢ ELECTRONIC INTEGRATION IS AN OPPORTUNITY FOR COMPOSITES
➢ COMPOSITES ENLARGE POSSIBILITIES FOR ELECTRONIC INTEGRATION
Neat for multi-functionality: example in the aeronautic sector

- **SECURITY & PREDICTIVE MAINTENANCE**
  - SHM (impact & cracks detection)
  - Motor monitoring

- **ENERGY HARVESTING**

- **IMPROVED OPERATION**
  - De-icing

- **ENHANCED COMMAND**
  - Human-machine interfaces

- **COMFORT & AGILITY**
  - Vibration damping
  - Cab soundproofing
  - Lighting

- **PARTS IDENTIFICATION**
  - Anti-counterfeiting
  - Recycling

- **ACTIVE DRIVE**
  - Active aerodynamics

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Electronic integration: an opportunity for composites

Additional functionalities

- Parts identification & monitoring
  - Anti-counterfeiting
  - Enhanced security
  - Predictive maintenance
  - End-of-life management

- Comfort enhancement & autonomous operation
  - Lighting
  - Thermal management
  - Human-machine interfaces

- Energy harvesting

Improve composite cost balance at component or sub-assembly level
TOWARDS ADVANCED FUNCTIONALIZATION OF SMART LIGHTWEIGHT COMPONENTS
Components

- PCB
  Source: projet européen PASTA

- Stretchable electronics
  Source: projet européen PASTA

- Printed electronics
  Source: ThinFilm

- Functional thread
  Source: Primo 1D

- Flex-PCB

- Surface Mounted Devices
Technologies for electronic integration

Overmoulding / Co-moulding
- Conductive metallic inserts
- Flexible electronics
- Wide array of solutions & components

Laser Direct Structuring (LDS®)
- Components miniaturization & count reduction
- 3D design freedom

Functional constituents
- Conductive resins (ESD, conduction)
- Electronics / conduction on reinforcement
- Use fibres & matrix for functions

Additive manufacturing
- Metallic inserts
- Printing sequence including component introduction
- Conductive inks
- Wide array of solutions & components

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Overmoulding for electronic integration

Process study

Influence of reinforcement nature

Design rules

Connected chistera

Connected foil

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Post-processing approach

Function description

- Part obtained with hybrid process, potentially painted
- Strain gage is «printed» on part thanks to Laser Direct Structuring®
  - Surface « component »
  - Customised design

Technology advantages

- Direct implementation of gage → accurate & non-intrusive measurement
- 3D design freedom → allows for complex measuring devices and connecting tracks
The HYPROD² platform

1. REINFORCEMENT PREPARATION
2. COMPONENT MOUNTING ON SMART TEXTILE
3. IMPREGNATION SMART PREG
4. PRINTED ELECTRONICS
5. MULTI-LAYER ASSEMBLY
6. SMART & HYBRID PARTS MANUFACTURING
7. TAPE PLACEMENT PRE-PROCESSING POST-PROCESSING
8. NDT & REPAIR
9. SIMULATION TOOLS PRODUCT/PROCESS SMART COMPOSITE

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THANKS FOR YOUR ATTENTION!

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