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Alpes Grenoble Innovation Recherche

Equipe CoMHet

Camille THIBAUT

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3SR Lab (S. Rolland du Roscoat, L. Orgéas)

LGP2 Lab (D. Chaussy, A. Denneulin, D. Beneventi)

Développement de matériaux bio-sourcés et fonctionnels pour l'impression 3D par extrusion

Development of innovative bio-based and functional materials for the production of 3D smart objects by 3D printing

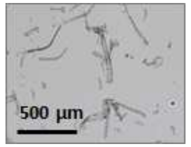
Context

+ Additive manufacturing (3D printing)

images : 3D hubs

- Complex and lightweight designs
- Short manufacturing lead time
- Free design modification
- Compatible with a broad range of materials (metal, plastics, ceramic, gel, food…)

+ Cellulose as a bio-based material



- Abundancy and availability
- Low cost
- Biodegradability
- Good mechanical properties
- Numerous derivatives with interesting properties (carboxymethyl cellulose, cellulose acetate, nanocellulose…)

= Additive manufacturing of cellulose

time

Binder jetting with cellulose powder

Sheet lamination with paper sheet

Material extrusion with cellulose suspension or pastes

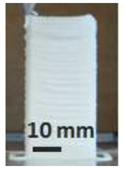
Method

• Formulation : Inert + functional material

Extrusion

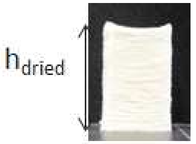
Homogeneous flow through small nozzle

Printing



Maintaining of filament and 3D solid shape after printing

Drying

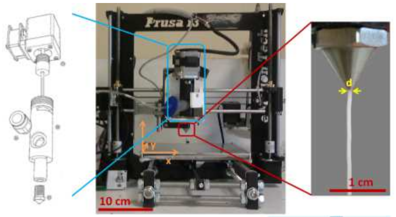


Maintaining of the 3D solid shape after air drying

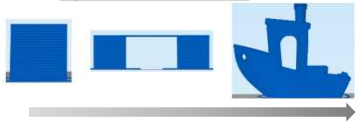
• 3D printer : process

Software parameters (layer height, extrusion width, printing speed..)

Device customization (dispensing, nozzle design, tank…)



3D simple geometry to more complex one



• Characterization

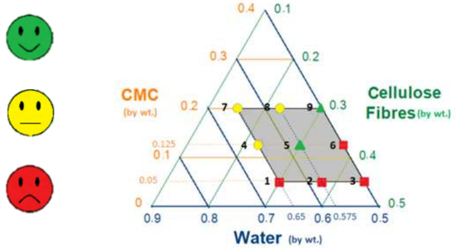
Dimensional reliability and structure (porosity)

Mechanical properties of the 3D printing part

Durability (aging, recycling)

Results

• Selection of a compatible formulation



Dry content: 35 to 50 wt%

• Characterization of this formulation

Rheology

Thinning behavior n = 0.2

Yield stress 6.0 ± 0.4 kPa

Strain after air-drying

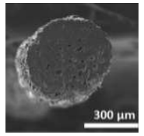
Longitudinal 3.5 ± 0.5%

Transversal 32 ± 1%

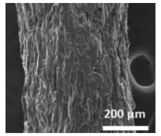
Mechanical properties

Young's modulus 5.4 ± 0.5 GPa

Microstructure (SEM)

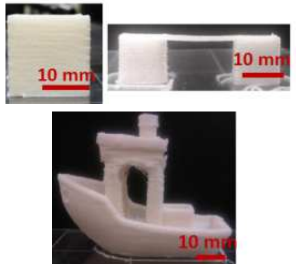


Cross-section

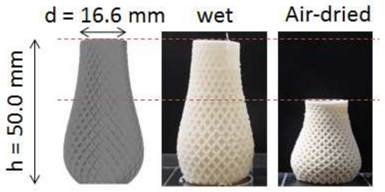


Surface

• 3D model printability



Accurate printing of models



Shrinkage upon drying