PROGRAMME DE COOPÉRATION TRANSFRONTALIÈRE
GRENSOVERSCHRIJDEND SAMENWERKINGSPROGRAMMA

Interreg
France-Wallonie-Vlaanderen

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# Processing / structure / properties relationships of 3D printed polymer and polymer blends

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Cofinancie
ring

met de steun van west-vlaanderen de gedreven provincie

Wallonie

AGENTSCHAP INNOVEREN & ONDERNEMEN

AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL
MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING

# How to control the properties of a 3D printed part made by fused filament fabrication?

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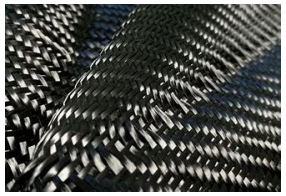
## Materials
(Thermoplastic polymers)

Rigid polymer

Soft polymer

Pure polymer

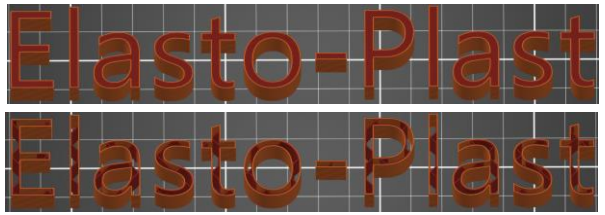
Composite



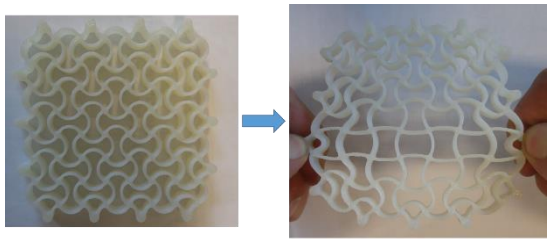
Etc

## Part structure

Density



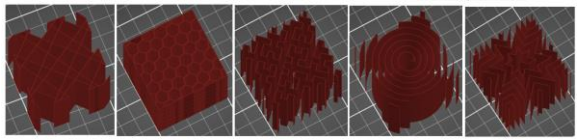

Architectural structures



Etc

## Process parameters

- Nozzle temperature
- Bed temperature
- Bead angle deposition
- Layer thickness
- Number of perimeters
- Filling density
- Filling patern



Etc

## Post processing

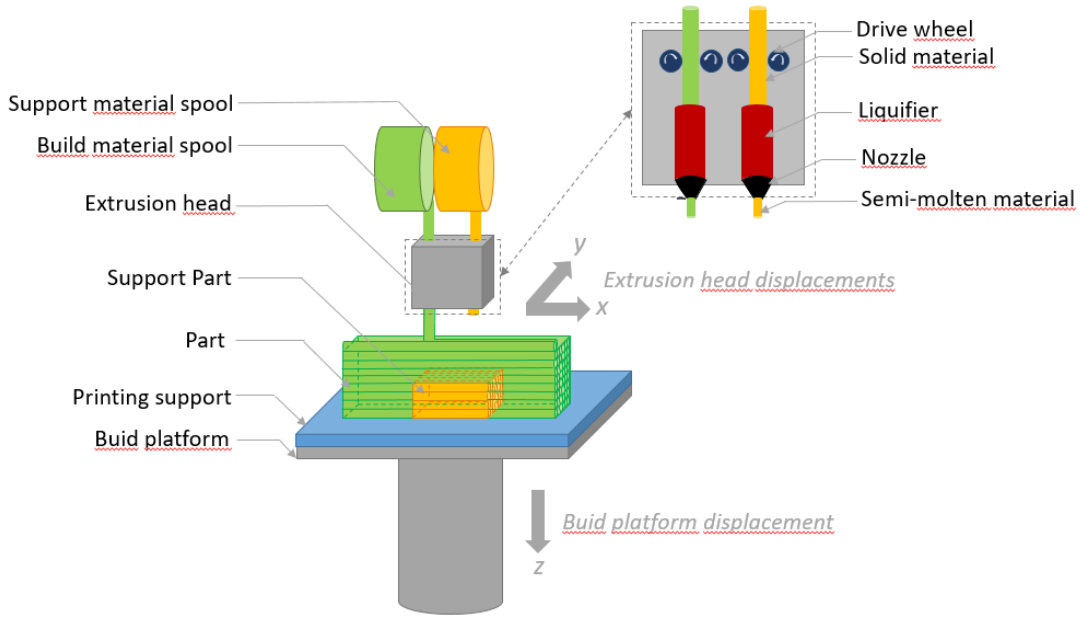
Surface coating

Annealing

Etc

Sébastien CHARLON

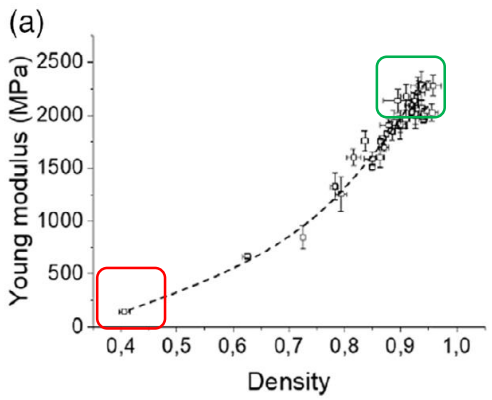
# Reminder: How does the FFF work?

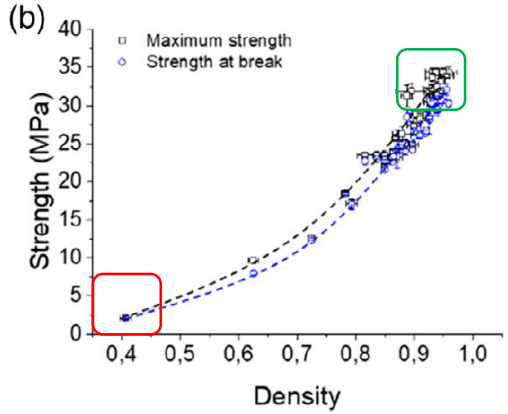



www.youtube.com/watch?v=WHO6G67GJbM&t=4s

56s
1min8s

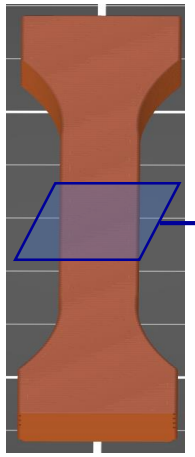
# FFF part = sucession of beads



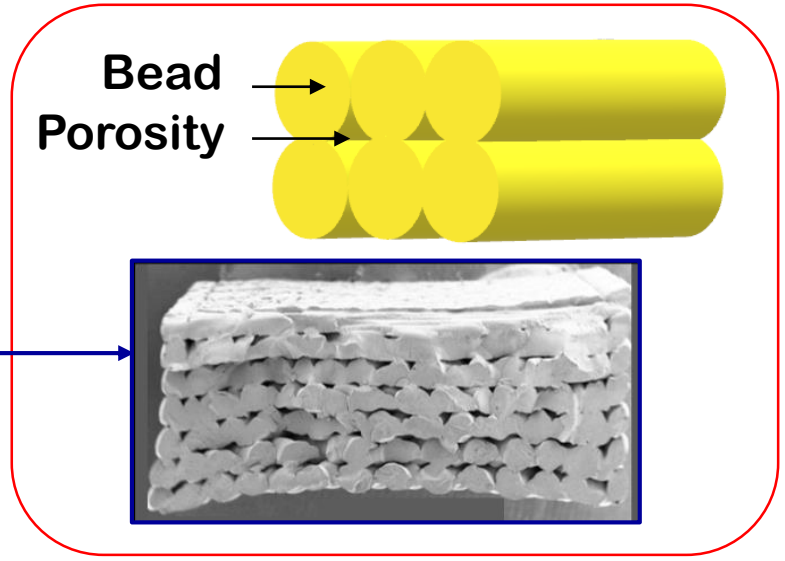




→ Mechanical properties = f(density)

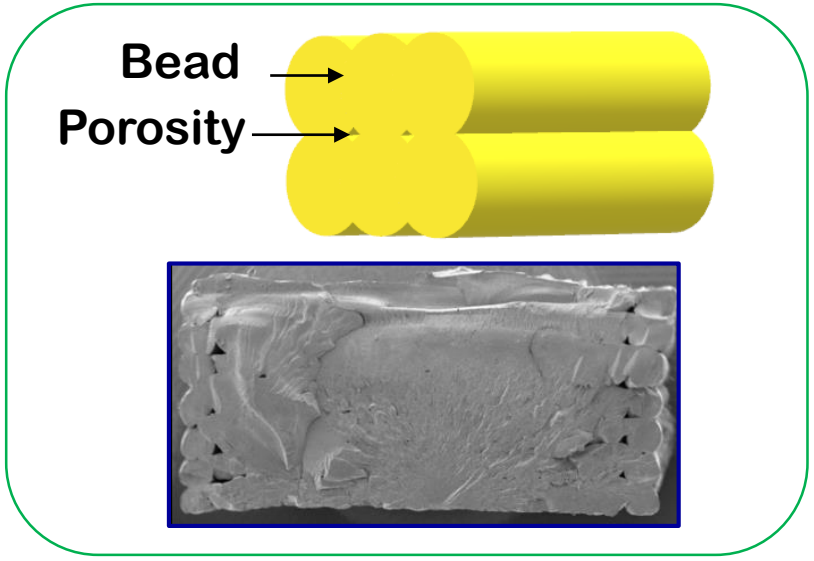
Δdensity?



Low mechanical properties

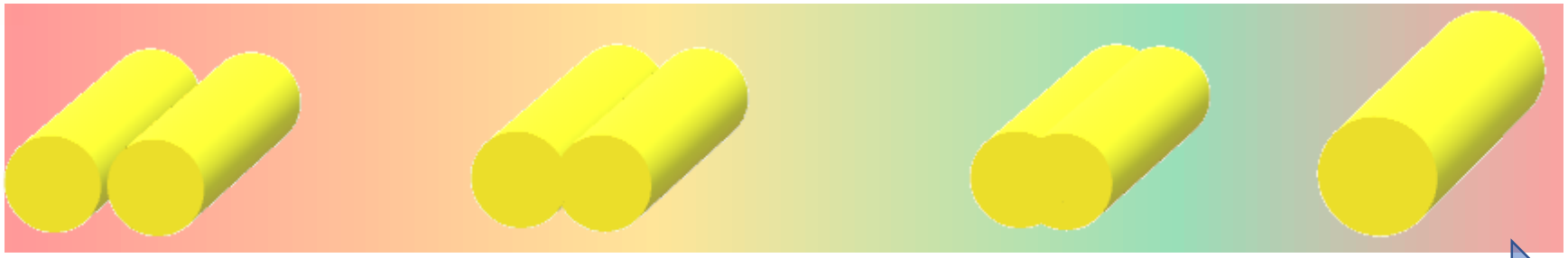



High mechanical properties




**Challenge**: Control of the level of porosity → mechanical properties

# Control of the coalescence between beads



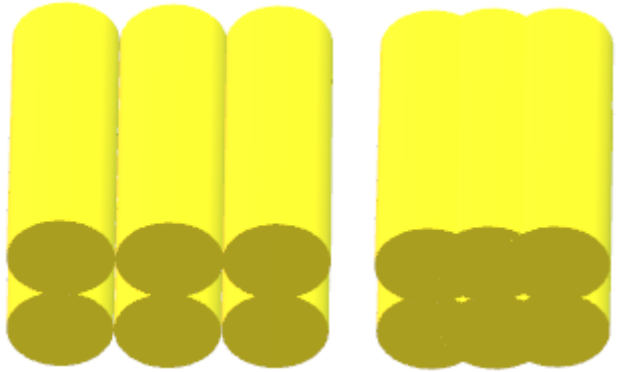
Coalescence level

0%

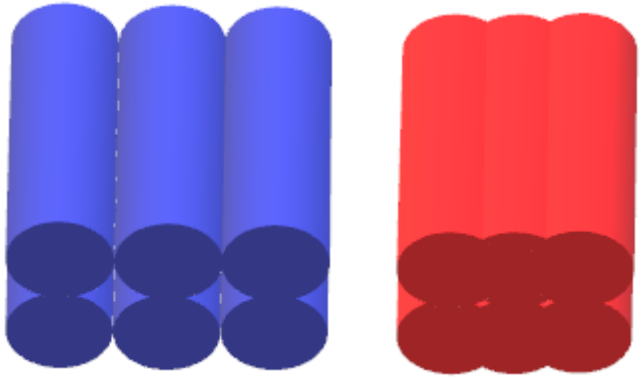
100%

Coalescence = f(contact beads, temperature)

**Contact bead** = f(process parameters )



**Polymer temperature** = f(process parameters)

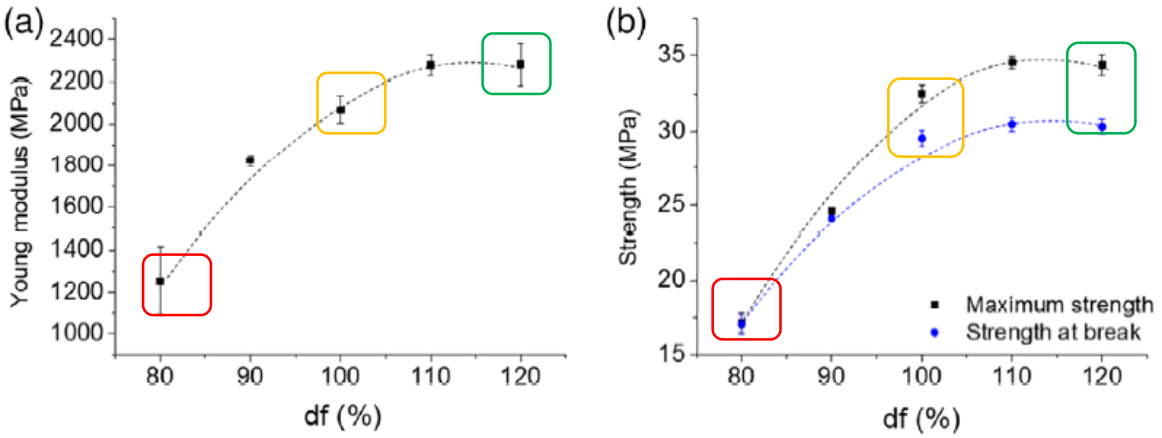


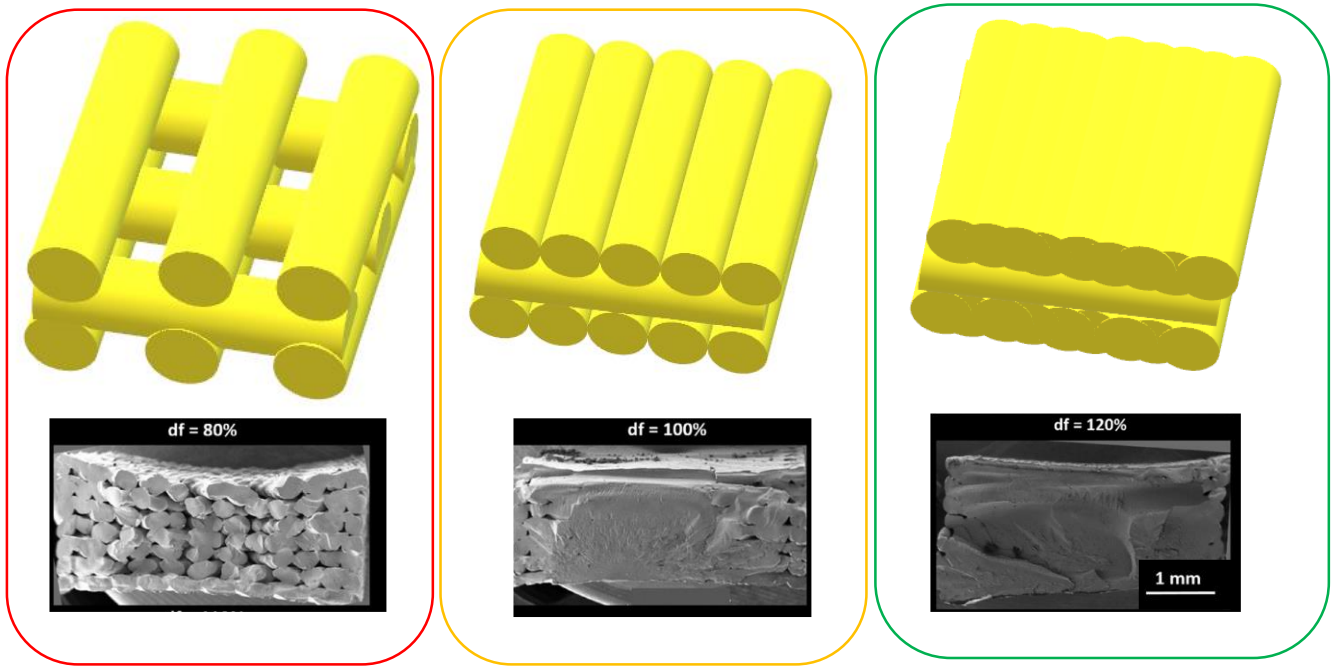
# Control of the coalescence between beads

**Coalescence = f(bead contact)**

→ **Parameters influencing mainly the contact between beads**

- **Filling density**
- Ratio bead volume / layer thickness
  - Bead volume
  - Layer thickness = slicing distance (SD)
- etc



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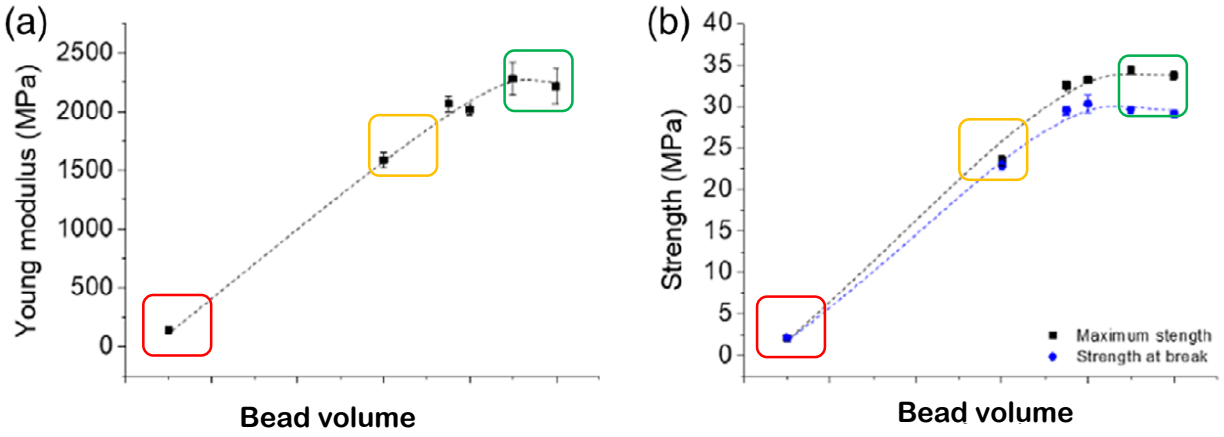
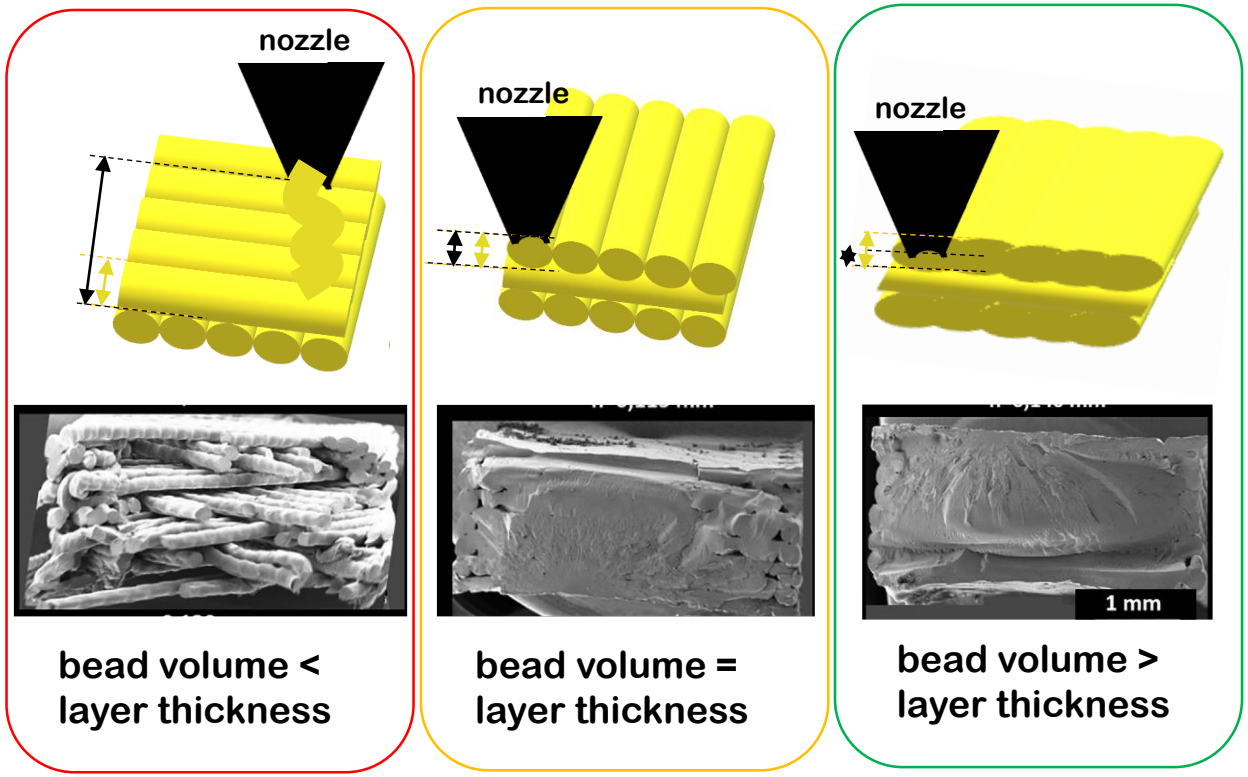



(constant layer thickness)



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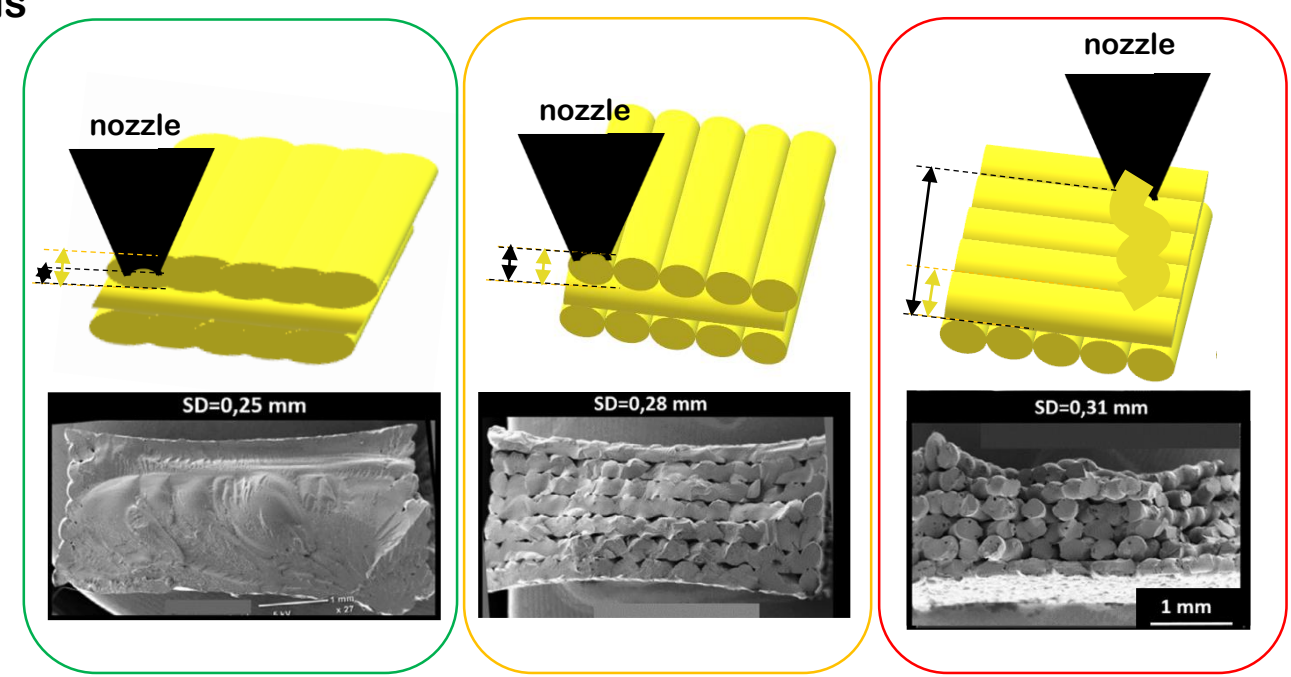
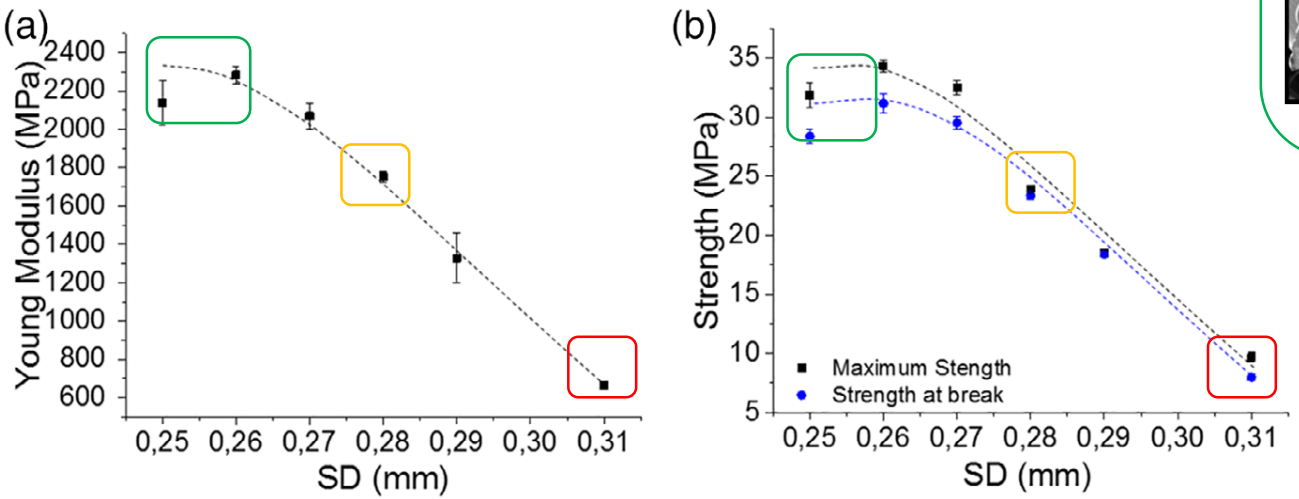
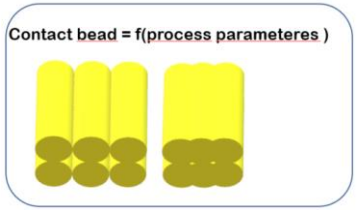
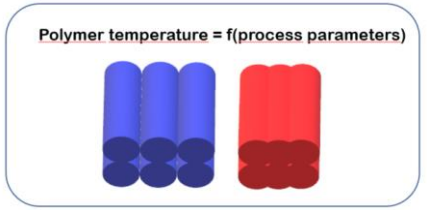



**(constant bead volume)**



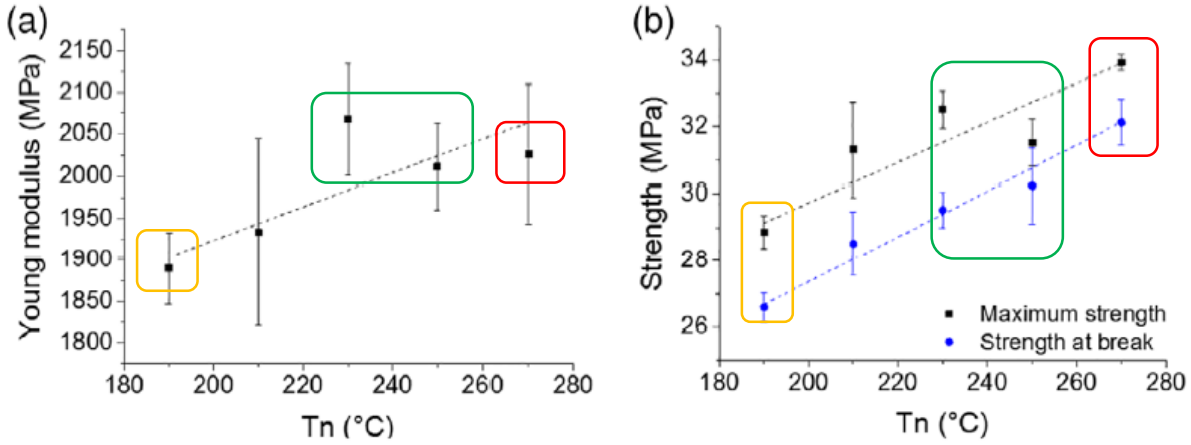



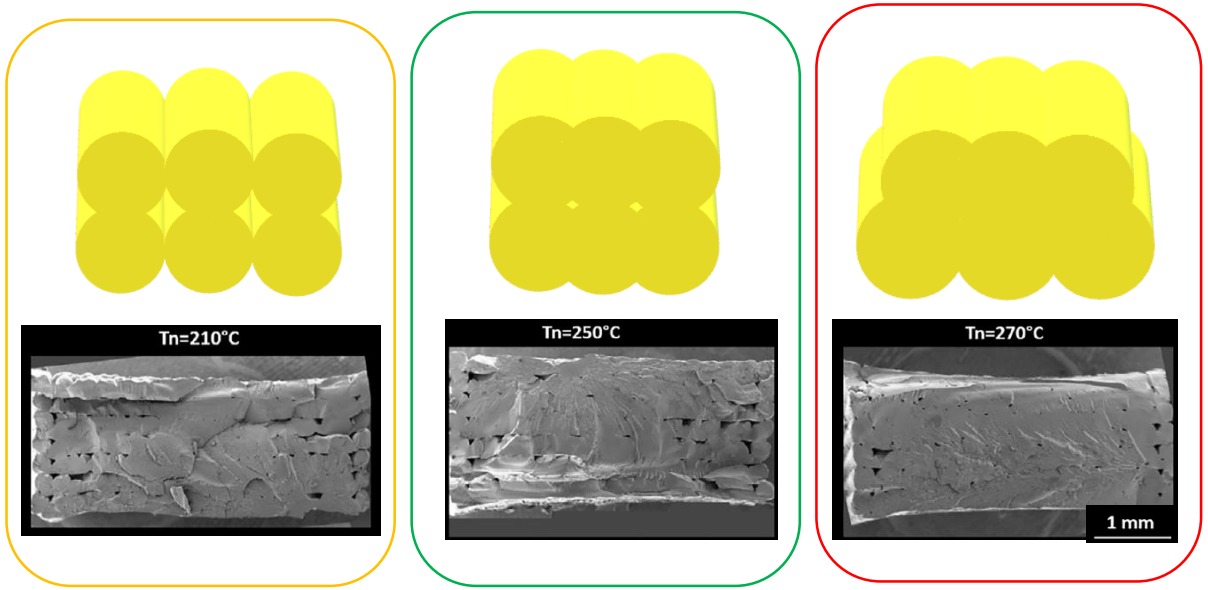
# Control of the coalescence between beads

**Coalescence = f( polymer temperature)**

→ **Parameters influencing mainly the polymer temperature**

- **Nozzle temperature**
- **Bed and/or manufacturing chamber temperature**
- **Bead angle**
- **Number of parts / fabrication job**
- **Etc**



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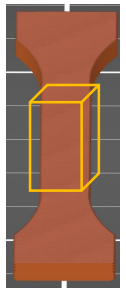

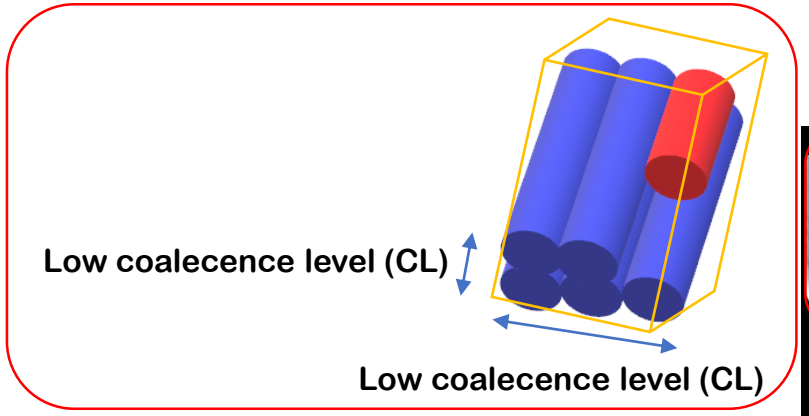


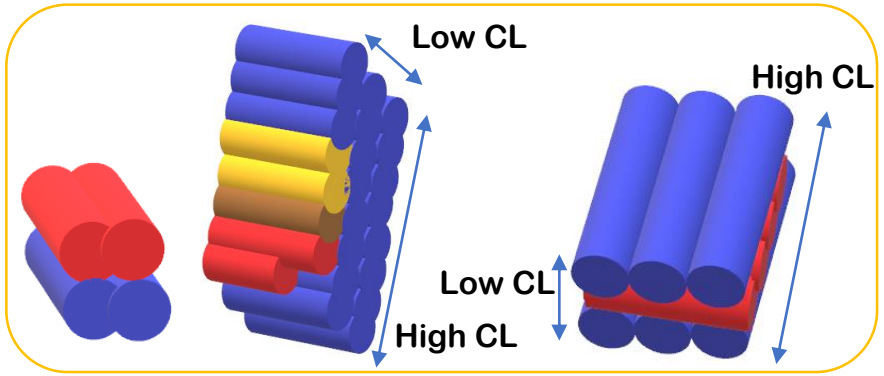


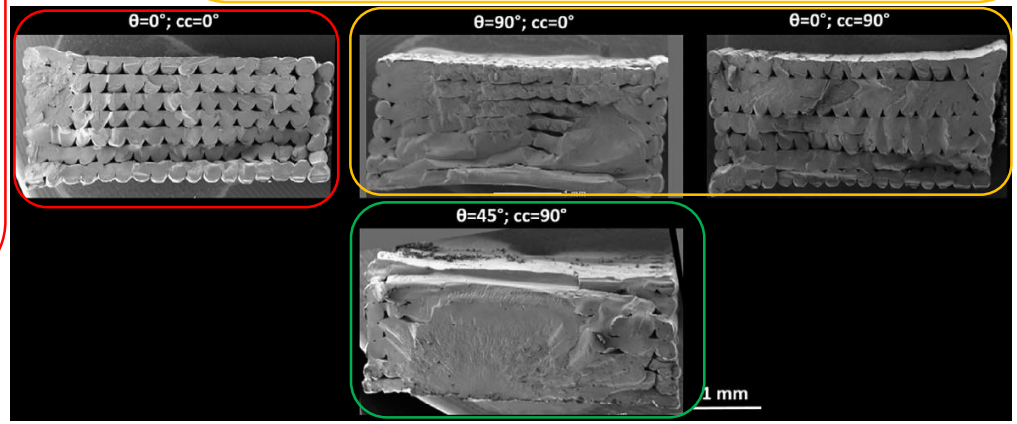


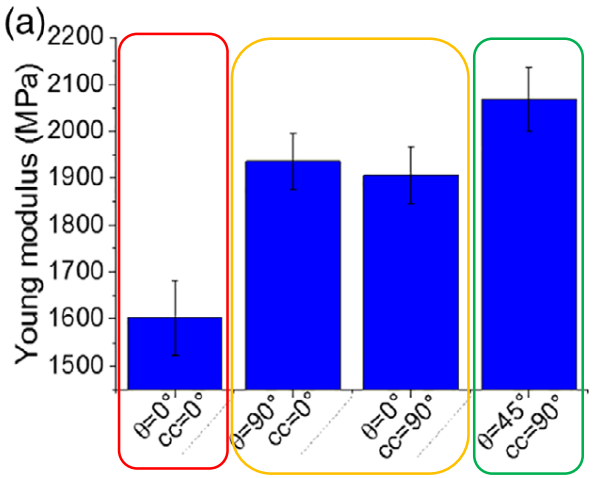


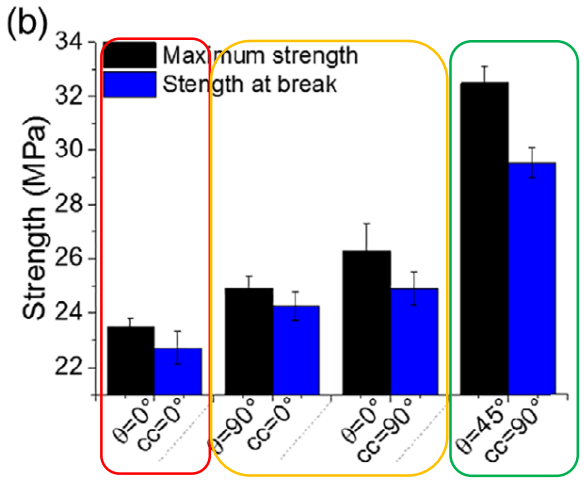


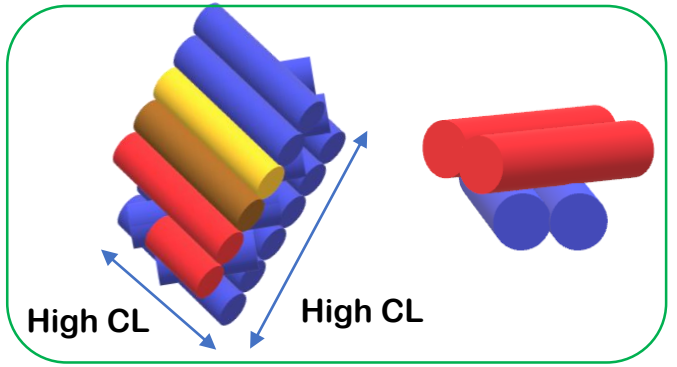

# Conclusion

Process parameters → Bead T°
→ Contact between beads
→ Bead coalsecence → Part density → Part mechanical properties

→ Control of the structure of a part made of elastomer
→ Interresting properties

*Thank you for your attention*

Samir KASMI → TPE/PLA blends

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Chef de file

Partners

Partenaires

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