Development of predictive tools for controlling the polymers morphing behavior in 4D printing

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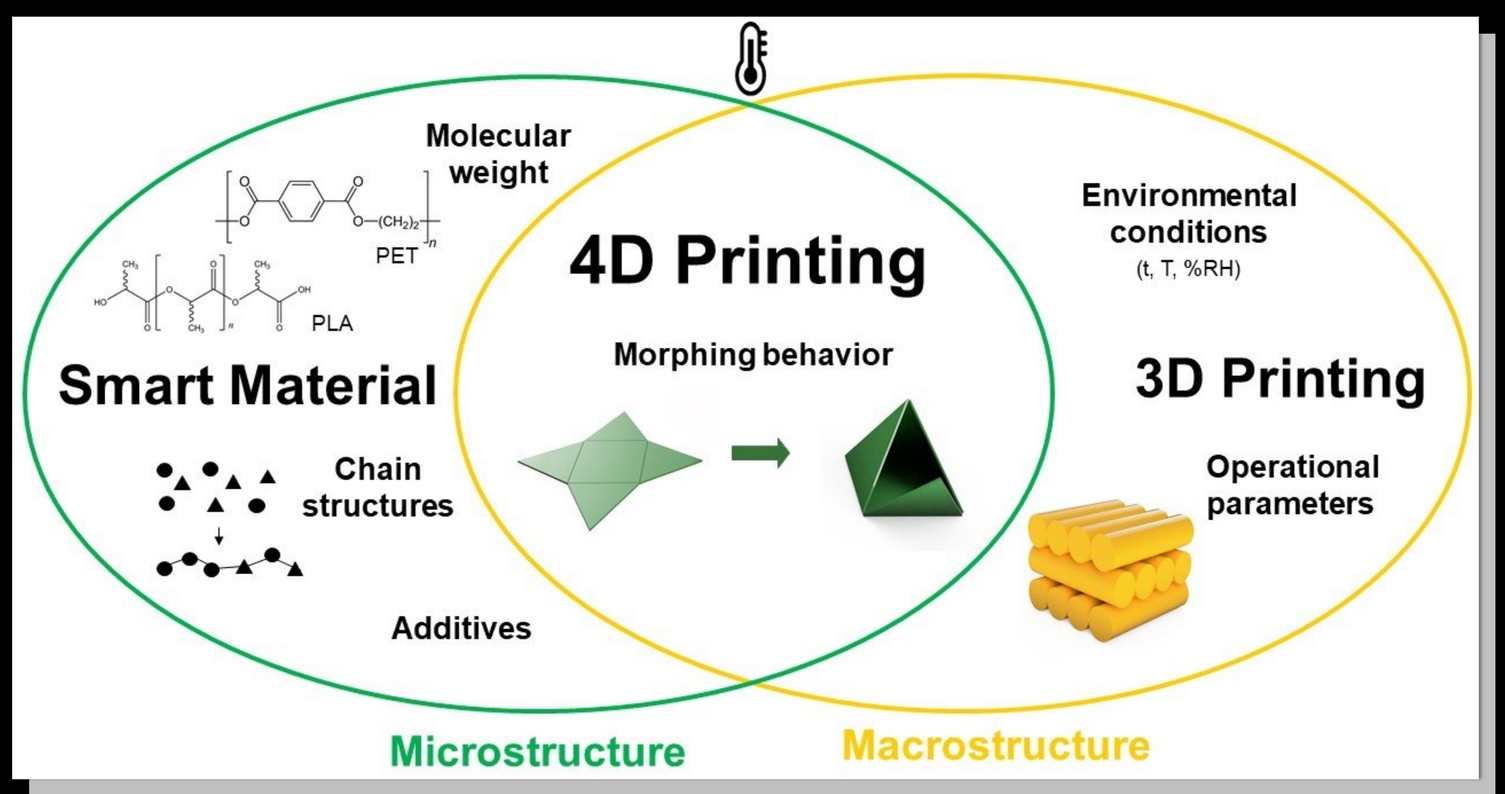
1. Scope & Aim

The integration of responsive materials to stimuli combined with 3D printing technology (4D printing) opens the possibility for solving processing issues, such as the production of complex structures. However, as 4D technology emerges from 3D printing, various challenges still need to be explored, such as the polymer's controlled morphing effect. This PhD thesis aims to study the influence of extrusion/deposition and 3D printing strategies on morphing effect of polylactic acid (PLA) and polyethylene terephthalate (PET).

2. Research Strategy



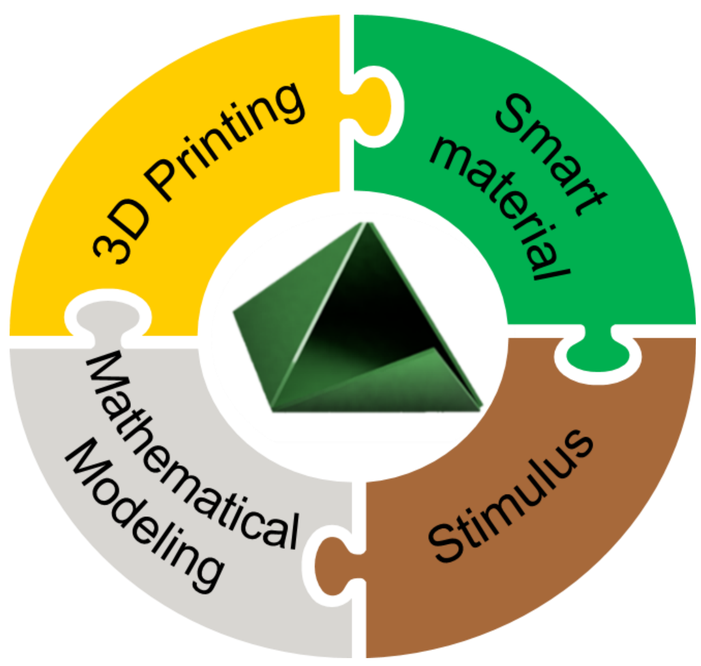
3. Methodology

1. Influence of PLA and PET macroscopic structure

- Definition and modeling of case study
- 3D Printing optimization
- Performance analysis

2. Influence of PLA and PET microscopic structure

- Control of parameterization of deposition conditions
- 3D printing
- Influence of plasticizers/fillers
- Physical, chemical, and mechanical characterization



3. Modelling and simulation of PLA and PET morphing

- Development of crystallization kinetics algorithms
- Development of numerical models for 3D printed material behavior simulation
- Integration of micro– and macrostructure simulation

4. Prototyping, testing, and validation

- Definition and modeling of case study
- Establish accuracy and limitations of the prediction model

4. Future perspectives

This PhD Thesis will create knowledge that will strength the 4D printing of thermoplastics. The new prediction tool will contribute for automatizing decisions in 3D printing of structures with shape changing ability, thus potentiating its worldwide massification.

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