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Cellulosic materials for 3D printing of complex objects



On January 8, 2020, Camille Thibaut defended her doctoral thesis of the University Grenoble Alpes, prepared under the supervision of the Professor Didier Chaussy, Aurore Denneulin, Associate Professor, Davide Beneventi, CNRS Research Director (Grenoble INP-Pagora / LGP2) and Sabine Rolland du Roscoat, Associate Professor (UGA / 3SR).

She presented the results of her research work entitled *Development of fibrous cellulosic materials for the production of bio-based 3D printed objects by extrusion*.

First, this project has evaluated the compatibility of aqueous and high solid content formulations with AM by extrusion. Formulations composed of micrometric organics fillers (cellulose fibers or powder and graphite powder) and cellulose derivatives (carboxymethyl cellulose) were investigated and results in a selection of homogeneous pastes with strong potential for AM by extrusion and limited deformation of the printed part upon air drying.

The second stage of this project focused on adjustment and optimization of AM by extrusion equipment and the related settings to guarantee an optimum shape accuracy of 3D printed parts compared to the 3D numerical model. A printing setting guideline and design limitations adapted to the developed paste were suggested. To characterize the printing parts, different innovative methods such as the temporal monitoring by X-ray tomography of a printed part upon drying were implemented.

The results of this project lead to the AM by extrusion of complex part 100% cellulose based with mechanical properties close to thermoplastic materials commonly used with fused filament fabrication process.

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Logo

logo-lgp2.eps

Grenoble INP-Pagora, the international school of paper, print media and biomaterials. The school is Quality, Safety & Environment certified and part of Grenoble INP, an engineering institute geared towards training "engineers who are creative, responsible and committed to a sustainable world". It trains engineers for the sectors of green chemistry, paper, printing, packaging, biomaterials and printed electronics. Its wide range of courses, pedagogical expertise and strong partnerships with industry allow it to continuously tailor its training to the needs of businesses and to the 60 graduates it produces each year, thus enabling them to embark upon stimulating careers in France and abroad. Grenoble INP-Pagora also develops international training in conjunction with several European universities: it offers a 2nd year engineering course and a Biorefinery & Biomaterials Masters, both taught in English. The innovative research performed by its LGP2 laboratory helps to improve processes and create products that meet all the latest requirements, notably those linked to the environment. These various activities ensure that the training offered is up to date with the latest scientific and technological advances.
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The Laboratory of Pulp and Paper Science and Graphic Arts (LGP2) is a joint research unit (UMR 5518) run by the CNRS, Grenoble INP and the AGEFPI. It conducts its scientific activities in conjunction with the academic community of Grenoble Alpes University. LGP2 comprises three teams: *Biorefinery: chemistry and eco-processes* – *Multiscale biobased materials* – *Surface functionalization through printing processes*. Their research strives to meet society's expectations when it comes to sustainable development (green chemistry, clean processes, recycling, biobased materials, renewable energy) and traceability & safety (functional materials, smart paper and packaging). pagora.grenoble-inp.fr/lgp2