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Numerical simulation of the micro-extrusion process of printable biomaterials

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3D printing has opened up new perspectives in the field of personalised medicine, with the possibility of manufacturing patient-specific implants or even bioprinting cells through microextrusion processes. Different types of inks have been developed for this purpose, with a wide spectrum of rheological properties, ranging from very thick ceramic pastes to very soft hydrogels. The knowledge and modelling of how rheological properties affect printability is an indispensable tool to design inks with better performance and to improve printing processes. The current study presents numerical simulations of the micro-extrusion process of printable biomaterials, with rheological properties extracted from experimental data.

As the first step, the proper rheological non-Newtonian models are extracted from experimental studies. Later, three-dimensional numerical simulation of extrusion process is performed in the context of Direct Numerical Simulation (DNS) of governing equations, where the whole physics of fluid motions is taken into account. The governing equations are solved using High-Performance Computing (HPC) parallel approaches [1, 2].

In the full-length article, the evolution of the non-Newtonian jet of the printable material with the rheological properties extracted from experimental data will be presented for different Reynolds numbers, in which toroidal oscillation phenomena might appear on the free surfaces.

REFERENCES

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