Design and 3D printing of hydrogel-based bioinks for tissue regeneration

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Transplantation is currently a major clinical challenge that can be resolved by 3D-printed organoids, *i.e.* self-organized three-dimensional multicellular microtissues which mimic the key functional, structural and biological complexity of an organ. Thanks to its high biocompatibility, biodegradability and low toxicity, alginate-based bioinks are synthesized to form cell-compatible hydrogels under physiological conditions. To that end, the methacrylation of sodium alginate is undertaken, followed by its rapid 3D bioprinting into complex architectures with high resolution features. In addition, physically crosslinked alginate microgels are further developped to encapsulate stem cells in a high-throughput and controllable manner. These are added to the alginate methacrylate to form the bio-ink. The cellular microencapsulations readily allow to 3D printed cell-loaded alginate hydrogels without damaging the cells during the printing process. Overall, the key parameters are the viscosity of the bioink, the UV exposure time, the diffusion of oxygen in the printed 3D system, their mechanical properties and the viability of the cells after printing. The latter open the prospect of further development of bio-inks and the improvement of the organoids currently being studied.