3D printing, wet spinning and cell culture with *N*-alkyl-D-galactonamide supramolecular hydrogels

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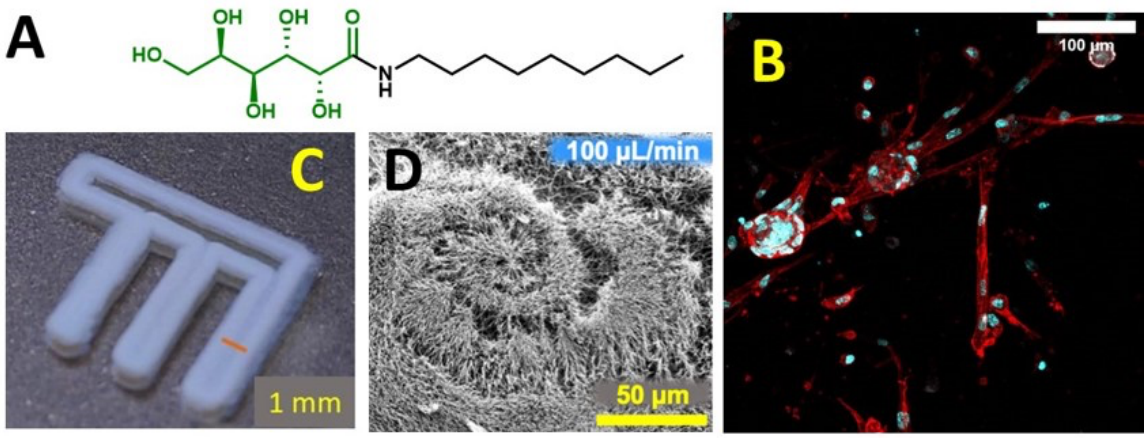
N-alkyl-D-galactonamides (Fig. A) are synthetic amphiphilic molecules that self-assemble in supramolecular fibers in water, giving hydrogels. These simple molecules are quite easy to synthetize in large quantity and high purity, which is suitable for biological applications. We showed that hydrogels of N-heptyl, N-octyl and N-nonyl-D-galactonamide are biocompatible and can be used as scaffold for 3D cell culture. On these hydrogels, neural stem cells, mesenchymal stem cells, fibroblasts or neural cell lines developed in 3D cell clusters linked together by cell extensions guided by the supramolecular fibers (Fig. B). Because the gels are fragile, specific methods have been implemented to observe the 3D cell organization after culture and immunostaining.

Methods to inject the hydrogels are also useful to make hydrogels in desired shapes and places. Because these hydrogels are not shear-thinning nor thixotropic, direct injection of the gels is not possible. It breaks irreversibly the gels. So, we developed a method in which the gelation is triggered in situ by liquid-liquid exchange. It has been applied to wet spinning and 3D printing. The very fast self-assembly of the gelator in contact with water provides well-resolved 3D printed patterns and well-shaped gel noodles (Fig. C). Also, by changing slightly the structure of molecular gelator, we got either sacrificial or persistent gels which can be imbricated by 3D printing. The spontaneous dissolution of the sacrificial gel gives supramolecular gel architectures with channels. In addition, at the microscopic level, in some conditions, the supramolecular fibers are radially organized highlighting diffusion and/or mixing phenomenon at the liquid-liquid interface (Fig. D).



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