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Bioinspired Processing of Complex Coacervates for Advanced Materials

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CIC biomaGUNE - Seminar Room

Complex coacervation is an associative liquid-liquid phase separation phenomenon driven by electrostatic attraction between oppositely charged macro-ions (e.g. polysaccharides, proteins etc.) and counter-ion release, resulting in a polymer rich aqueous phase in equilibrium with a polymer poor phase [1]. For a given polyelectrolyte couple, depending on the salt concentration of the medium, a complex coacervate either behaves as a free-flowing viscoelastic fluid or a rigid polyelectrolyte complex or anything in between [2]. This outstanding versatility has made complex coacervates good candidates for a wide range of applications [3]. In the Kamperman group at the Zernike Institute for Advanced Materials at the University of Groningen, we are dedicated to improve and engineer complex coacervates to introduce novel advanced functional materials such as underwater adhesives [4], double network hydrogels, 3D printing biomaterial inks and responsive Pickering emulsifiers micelles.
In this presentation, I will particularly focus on the use of hyaluronic acid – chitosan complex coacervate as a biomaterial ink for 3D printing. By carefully optimizing, the physico-chemical parameters of the system, meaning pH, salinity and molecular weight of the polymers, we were able to produce a set of biomaterial inks that can be used in different environmental conditions. The developed inks can not only be dried and re-hydrated without loss of shape fidelity, but also be printed into a liquid medium (fresh-printing) without the need of any chemical modification or post-printing curing process. These promising results show the potential of coacervate-based biomaterial inks to be used as 2D and 3D scaffolds in cell culture studies.

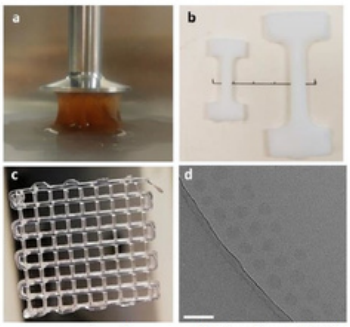

Figure 1. *Applications of complex coacervates as a) underwater adhesive, b) sacrificial network for double network gels, c) ink for 3D bioprinting and d) emulsion stabilizer micelles. Scale bar is 100 nm.*

References [1] C. E. Sing, S. L. Perry, Soft Matter, 2020, 16, 2885-2914
[2] Q. Wang, J. B. Schlenoff, Macromolecules 2014, 47, 3108-3116
[3] L. Zhou, H. Shi, Z. Li, C. He, Macromol Rapid Commun 2020, 2000149
[4] M. Dompé, F. J. Cedano-Serrano, O. Heckert, N. van den Heuvel, J. van der Gucht, Y. Tran, D. Hourdet, C. Creton, M. Kamperman, Advanced Materials 2019, 31, 1808179