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Polymeric microcarriers for the tunable co-delivery of two incompatible APIs

This lecture proposes to study the continuous-flow production and the release properties of polymeric microcarriers whose size and morphology were controlled thanks to droplet microfluidics. Special attention will be paid to the co-delivery of two incompatible active pharmaceutical ingredients and to the tuning of the release profiles by varying operating and materials parameters.

Poly(acrylate) plain microparticles, loaded with a hydrophobic model drug (ketoprofen), were produced from an off-the-shelves capillary-based droplet generator assembled within minutes. The dispersed phase, composed of a mixture of mono- and poly-functional monomers admixed with the drug and a photoinitiator, was emulsified by a viscous aqueous solution into size-controlled droplets which were downstream polymerized on-the-fly by UV irradiations. The drug-release profile was easily tuned by varying i) the weight ratio between the two co-monomers and ii) the continuous to dispersed phase flow rate ratio. By using the aforementioned capillary-based droplet generator, poly(acrylamide) Trojan microparticles embedded with ketoprofen-loaded poly(ethyl-methyl acrylates) nanoparticles, previously obtained from the nanoemulsification of the monomer phase within an elongation flow micromixer, enable to release up to 50% of the encapsulated drug in a sustain manner.

The use of a second capillary made possible the production of 2-domain polymeric microparticles encapsulating in each domain two different and incompatible model drugs (ketoprofen and sodium fluorescein or ranitidine HCl). Thus PH-sensitive poly (methyl acrylate)-poly (acrylamide/ carboxyethyl acrylate) core-shell on one hand and Janus poly(methyl acrylate)-poly(acrylamide) microparticles on the second hand were obtained by the emulsification into droplets of two immiscible drug/monomer phases with a viscous oil phase. Then, droplets were downstream polymerized by UV irradiations at 365 nm far away from the maximum absorption wavelength of the two drugs thus ensuring their integrity. Co-release profiles were found to be function of both the morphology of the microparticles and their size and could be tuned by changing the flow rates of the two dispersed and continuous phases.

Speaker Biography

Christophe A Serra is Professor at the University of Strasbourg teaching at the European School of Chemistry, Polymers and Materials Science (ECPM). He received his MS and PhD degrees in chemical engineering from the National Engineering School of the Chemical Industries (Nancy) and Paul Sabatier University (Toulouse), respectively. His researches concern the development of intensified and integrated microfluidic-assisted polymer processes for the synthesis of architecture-controlled polymers and functional micro structured polymer particles.

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