Microfluidic Design of Biodegradable Nanomaterials with Tuneable Morphology and Dimensions

Contact

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Internship level Master 2

Starting and duration Six months starting in January 2024

Keywords Microfluidics; Self-assembly; Nanoprecipitation; Nanomedicines

Context

Since the 1970s, polymeric nanomaterials (NM) have emerged as promising systems with numerous advantages over conventional formulations.[1,2] They have shown ground-breaking achievements in improving drug efficacy/toxicity ratio, controlled drug release, and targeted drug biodistribution by efficiently bypassing biological barriers.[3] Among the criteria defining synthetic identity, NM morphology has been considered during the last decade as a novel parameter that plays a pivotal role in controlling biological processes.[4,5] Nonspherical NM have been generated using different fabrication techniques divided into bottom-up and top-down approaches. However, most of those techniques are batch processes that have several drawbacks: (i) they result in large particles (typically >150 nm), (ii) high polydispersity, and (iii) high batch-to-batch variation. Those drawbacks are sub-optimal for biological applications. To address current challenges in NM formulation, microfluidic technologies have been used to prepare NMs with controlled physicochemical properties[6] and good reproducibility.

Internship Description

The project aims to design biodegradable NM with controlled morphology and dimensions. NM are composed of biodegradable poly(lactic acid) stereocomplexes.[7] Those materials provide unique properties, such as the control of the molecular architecture. NM composed of poly(lactic acid) stereocomplexes will be designed in a microfluidic device. The impact of process parameters on NM morphology and dimensions will be investigated. Once prepared, NM dimensions, concentration, morphology, volume, surface-specific areas, mechanical properties, and surface potential will be assessed. Investigating NM behaviors toward cells could be studied depending on the internship progression and the candidate's motivation.

Candidate profile

Applicants should have a PharmD or a bachelor's degree in polymer chemistry, physical chemistry, colloids, or formulation. The motivation in microfluidic process engineering could be an added value.

How to apply?

Applicants will send a motivation letter and a CV comprising the names of two references to kawthar.bouchemal@chimieparistech.psl.eu and joshua.mcgraw@espci.fr

References

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