Elaboration of the size-controlled polymeric nanomaterials; a model drug encapsulation and in-vitro release studies

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Drugs representing 40% of all the industry are poorly soluble. Considering a strong demand for the continuous injection of drugs for long-term treatments, these ingredients are required to be delivered. In this regard, biodegradable polymeric nanoparticles (NPs) encapsulating a drug are considered as promising materials for drug delivery systems (DDS).[1] NPs small size increases stability of the system in different media and favours drug release and targeting.[2]

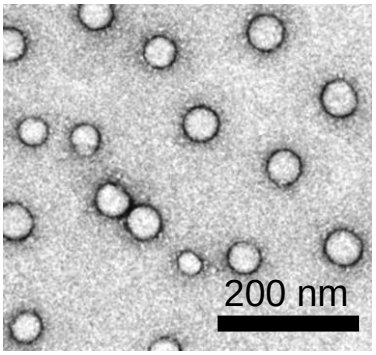

Figure 1. TEM image of PLGA DNPs

In this study, the elaboration of size-controlled NPs of poly(lactic-co-glycolic) acid (PLGA) was first investigated by comparing different emulsification devices, namely sonicator, shear mixer and a microfluidic device called elongational-flow reactor and mixer (μRMX), followed by the evaporation of the polymer solvent (ethyl acetate). Polymeric NPs were successfully produced and effects of process devices and operating parameters on NPs size and size distribution were thoroughly quantified by TEM and DLS measurements. Given the robustness and better control on NPs size obtained in the microfluidic process, PLGA NPs loaded with a hydrophobic model drug (rifampicin) at 4 different concentrations were then produced. First, it was found that the presence of the drug in the polymer phase during emulsification decreased PLGA DNPs' size (Figure 1) and was explained by a significant change in the interfacial tension between the polymer phase and the continuous aqueous phase. Then in-vitro tests were performed to determine the cumulative drug release under sink conditions.

References:

[1] J. Majumder, T. Minko, J. Adv. Therap. 2021, 4, 2000203.

[2] M. Vauthier, C.A. Serra, Polym. Int., 70, 2021, pp. 860-865.