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Microfluidics-based manufacture of PEG-b-PLGA block copolymer nanoparticles for the delivery of small molecule therapeutics

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With methods exist for the production of block copolymer nanoparticles as drug delivery vehicles, it is challenging to maintain consistent nanoparticle quality and size, control size, and scale up to larger volumes. Here, we describe nanoprecipitation of block-co-polymer nanoparticles using a scalable, reproducible microfluidic mixing platform. Optimization strategies and encapsulation of a hydrophobic model drug coumarin-6 were investigated. Rapid and controlled microfluidic mixing of an organic solvent containing coumarin-6 and PEG5000-b-PLGAX of varying molecular weights of the hydrophobic block (X), with an aqueous solution produced nanoparticle diameters below 100nm. Instrument parameters such as aqueous:organic flow rate ratio and total flow rate had a significant impact on nanoparticle size. Increasing the molecular weight of the PLGA block from 10000-95000 resulted in an increase in the size of the nanoparticles from 25-60nm. However, changes in the total flow rate of the instrument enabled all the nanoparticles to be tuned to a similar size of 60nm which is difficult to control using conventional techniques. Microfluidic preparation achieved an encapsulation efficiency of 52% w/w - significantly higher than that obtained by co-solvent evaporation technique (34% w/w). The size of the nanoparticles prepared using the NanoAssemblr platform were smaller than that prepared using co-solvent evaporation. We have successfully demonstrated proof-of-concept for production of PEG-b-PLGA nanoparticles encapsulating a model hydrophobic drug using a scalable microfluidic platform that can be applied to producing other hydrophobic drug-loaded block-co-polymer formulations.

Biography

Shell Ip is a Technical Marketing Specialist. He is a Science Communicator with a comprehensive knowledge of nanotechnology applications in Medicine and Life Sciences. He combines his multidisciplinary background with an aptitude for communication to convey concepts to diverse audiences through peer-reviewed publications, application notes, scientific posters and articles for precision nanosystems. He has a BASc in Engineering Science and a PhD in Chemistry from the University of Toronto. In his Post-doctoral and Doctoral Research, he has developed lipid coatings to render inorganic nanomaterials biocompatible and to tailor their surface properties for biosensing and biodiagnostics applications.

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