The University of Adelaide

MICROFLUIDIC SYSTEM DEVELOPMENT FOR DRUG DELIVERY

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Abstract

Development and application of a microfluidic system for generating drug delivery carriers are investigated in this research. Various types of microfluidic devices are designed and fabricated for peptide nanotubes, liposome vesicles and double emulsions formation. The microfluidic system offers a better control over the formation process of all three drug delivery carriers. Comparing to traditional methods such as bulk mixing, the process efficiency, size and size distribution of the final products are significantly improved.

The results generated show that tuning the flow rate ratios between different reagents from the inlet streams successfully controls the sizes and size distributions of liposomes vesicles. The relationship between the flow rate ratio and the size of the resulting vesicles is established. Macrocycle (AP-169) that was found to self-assemble into an anti-parallel β-sheet nanotube with a triggering agent is successfully synthesized and purified for peptide nanotube self-assembling process. A microfluidic device is designed and fabricated to control the interaction between AP-169 and its self-assembling triggering agent, dimethyl sulfoxide.

Double emulsions with different radii are produced with the microfluidic system by adjusting the flow rate ratio between each phase of the solution, and changing the wetting properties of the microchannels. The stability of double emulsions is enhanced by introducing various surfactants. The sizes and size distributions of liposomes and double emulsions have been successfully controlled and optimized for drug delivery.

In conclusion, various drug delivery carriers have been successfully generated and optimized with a designed and modified microfluidic system. These products can be further applied in drug encapsulation, biomolecular screening and *in vitro* compartmentalization in the future.

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