A new advancement technique for the formation of highly uniform engineered functional nanoparticles with pharmaceuticals tailored properties by membrane dispersion cell

This item was submitted to Loughborough University's Institutional Repository by the/an author.


Additional Information:

- This is a poster presented at the Loughborough University Research Conference 2015.

Metadata Record: https://dspace.lboro.ac.uk/2134/19731

Version: Accepted for publication

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: https://creativecommons.org/licenses/by-nc-nd/4.0/

Please cite the published version.
1. Research highlight: What is functional nanoparticle?

Functional nanoparticles (NPs) are scientifically defined as solid, colloidal particles or carriers in the range 10-1000 nm [1] with numerous functions such as; (i) protections of active ingredients (drugs) against degradation, (ii) targeting of drugs to specific sites of action (organ or tissue), and (iii) delivery of biological molecules such as proteins, peptides and oligonucleotides depending upon their administration routes either orally, parenterally or locally [2].

2. New advancement techniques: Membrane system & nanoprecipitation method

NPs were produced instantaneously by fast diffusion (nanoprecipitation) coming into contact with the aqueous phase that flows tangentially to the membrane surface.

3. Materials and parameters setting

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Materials/Properties</th>
<th>Compositions/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous phase</td>
<td>Mill-Q-water + surfactant (Depending on V_in/V_out)</td>
<td></td>
</tr>
<tr>
<td>Organic phase</td>
<td>Dissolved mixture of polycaprolactone (PCL) + drug (rapamycin) in acetone 6 g/l PCL + 40 w/w% rapamycin (RAPA)</td>
<td></td>
</tr>
<tr>
<td>Membrane</td>
<td>Pore size = 10 μm Stainless steel (SS) membrane</td>
<td></td>
</tr>
<tr>
<td>Optimum exp. parameters</td>
<td>(i) Volume ratio (V_in/V_out) (ii) Stirring speed (rpm) (iii) Injection rate (ml/min)</td>
<td>(i) 10.0 (ii) 1300 rpm (iii) 5 ml/min</td>
</tr>
</tbody>
</table>

4. NPs physical characterisations & images

5. Conclusions

- Micro-engineered membrane system is shown to be convenient for production of highly controllable size of NPs that can be applied as a drug carrier with any substitution elements (eg: drug or nanofillers).
- The higher the aqueous-to-organic volume ratio, the higher the dilution factor of the polymer in the liquid phase and the lower the rate of particle growth after nucleation, resulting in smaller particle size.

Acknowledgements

This work was financially supported by the Ministry of Higher Education of Malaysia and the European Research Council grant no. 280106-CrySys.