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Electrospraying of active carrier matrix systems with varying hydrophobicities

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The electrohydrodynamic atomisation (EHDA) technique is optimised for the production of uniform nanoparticles via the atomisation of liquids through the use of electrical forces (Haj-Ahmad et al., 2015). The EHDA technique is a single step process specifically used for the production of particles and fibers in the micro/nano range. It is possible to use this process for the encapsulation of drugs/actives within a polymeric matrix for release over time. The efficiency of particle engineering is affected by a number of factors namely the flow rate of polymeric solution, applied voltage and finally the distance between the nozzle and the collection plate. The electrospraying process gives rise to the production of nanoparticles (NPs) which can be used as particulate active matrix systems. The electrospraying process was deployed for polymers (PCL, PLGA and PMSQ) with varying hydrophobicities and was investigated to determine the impact of engineering parameters on the hydrophobic nature and outcome of polymer solutions. The physical properties of the polymeric solutions were characterised and these solutions were then sprayed using electrohydrodynamic atomisation (EHDA) and were analysed using optical and SEM. The spraying process was optimised using varying flow rates and applied voltages for each medium, these were found to be 80 µL/min and 13.2kV for PCL, 80 µL/min and 10.2kV for PLGA and 80 µL/min and 15.5kV for PMSQ. The process was observed using real time imaging (optical zoom camera and several jetting modes were observed). SEM showed the formation of spherical uniform particles for PCL, particles formed from PLGA also showed the formation of spherical particles however these had agglomerated appreciably and finally PMSQ displayed bowl shaped morphology after processing. It is possible to suggest both process parameters and the hydrophobic nature of the polymer play a part in topographical and morphological features of nanoparticles.

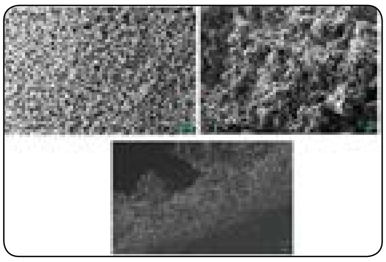

Figure 1. Electron Micrographs PMSQ, PCL and PLGA respectively at 1K magnification.

Recent Publications:

1. Mehta, P., Haj-Ahmad, R., Rasekh, M., Arshad, M., Smith, A., van der Merwe, S., Li, X., Chang, M. and Ahmad, Z. (2017). Pharmaceutical and biomaterial engineering via electrohydrodynamic atomization technologies. Drug Discovery Today, 22(1), pp.157-165.
2. Rai, P., Gautam, N. and Chandra, H. (2017). An Experimental Approach of Generation of Micro/Nano Scale Liquid Droplets by Electrohydrodynamic Atomization (EHDA) Process. Materials Today: Proceedings, 4(2), pp.611-620.
3. Huang, X., Gao, J., Li, W., Xue, H., Li, R. and Mai, Y. (2017). Preparation of poly(ε-caprolactone) microspheres and fibers with controllable surface morphology. Materials & Design, 117, pp.298-304.
4. Li, W., Liu, S., Yao, H., Liao, G., Si, Z., Gong, X., Ren, L. and Wang, L. (2017). Microparticle templating as a route to nanoscale polymer vesicles with controlled size distribution for anticancer drug delivery. Journal of Colloid and Interface Science, 508, pp.145-153.
5. Liu, Z., Zhang, Y., Yu, D., Wu, D. and Li, H. (2018). Fabrication of sustained-release zein nanoparticles via modified coaxial electrospraying. Chemical Engineering Journal, 334, pp.807-816.

Biography

Aliyah S Zaman is currently a PhD student starting my second year of my research working within the area of biomaterial engineering. I have progressed rapidly with my research through hard work and dedication, and I am currently undertaking experiments as part of my PhD whilst writing paper for publication specifically relevant to my research. I support first year pharmacy students within their practical classes assisting with relevant calculations and the process required to produce certain products, alongside which I also mark their work and provide feedback.

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