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Electrospraying of active carrier matrix systems with varying hydrophobicities

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The electro hydrodynamic atomization (EHDA) technique is optimized for the production of uniform nanoparticles via the atomization of liquids through the use of electrical forces. 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 characterized and these solutions were then sprayed using electrohydrodynamic atomization (EHDA) and were analysed using optical and SEM. The spraying process was optimized using varying flow rates and applied voltages for each medium, these were found to be 80 µL/min and 13.2 kV for PCL, 80 µL/min and 10.2 kV for PLGA and 80 µL/min and 15.5 kV 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.

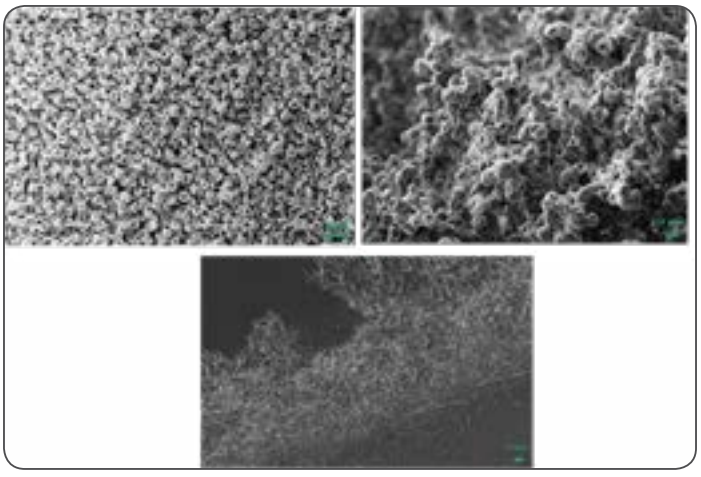

Figure: Electron micrographs PMSQ, PCL and PLGA respectively at 1 K magnification.

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):157-165.
2. Rai P, Gautam N and Chandra H (2017) An experimental approach of generation of micro/nano scale liquid droplets by electro hydrodynamic atomization (ehda) process. Materials Today: Proceedings 4(2):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 and Design 117: 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 508:145-153.
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 334:807-816.

Biography

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

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