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Electrospun coatings for micron scaled medical devices

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The complexity of the structure of the skin poses a great challenge for transdermal drug delivery. One of the most recent developments in drug delivery devices in this remit are microneedles (MNs). Electrohydrodynamic Atomization (EHDA) can be used to produce nanoparticle or nanofibre MN coatings via electrospraying or electrospinning, respectively. As well as applications in drug delivery and vaccine delivery, coated MNs also have the potential to be utilised for biomedical and other analytical uses (e.g. allergies, sensors). Here, stainless steel MNs were coated using electrohydrodynamic atomisation (EHDA) by varying the setup (collection methodology and deposition distance) which led to optimisation of the process thus producing nano and micron sized particular and fibrous structures. The coating formulation consisted of a PVP matrix system, fluorescein dye (model active, disease state marker) with ethanol as vehicle. Using these excipients and manipulating EHDA process parameters, led to deposition of particles (100 nm to 3um) and fibres (400 nm to 1 um) onto MNs in a controlled manner (flow rate range of -5-50 uL/min, varied applied voltage 6-19 kV), confirmed with SEM analysis. This study displays the capability for targeting as well as analysis alongside potential for a novel medical device capable of delivering active therapeutic ingredients on a micron and even nano scale.

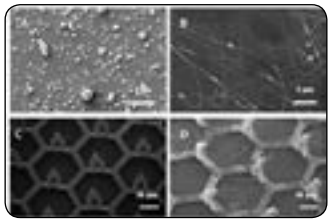

Figure 1: A) SEM low Mwt (4.4x104) PVP, B) high Mwt (1.3x106) PVP, C) uncoated microneedles, D) coated microneedle at 5000x magnification

Recent Publications:

1. Larrañeta, E., Lutton, R., Woolfson, A. and Donnelly, R. (2016). Microneedle arrays as transdermal and intradermal drug delivery systems: Materials science, manufacture and commercial development. Materials Science and Engineering: R: Reports, 104, pp.1-32.
2. 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.
3. Dillon, C., Hughes, H., O'Reilly, N. and McLoughlin, P. (2017). Formulation and characterisation of dissolving microneedles for the transdermal delivery of therapeutic peptides. International Journal of Pharmaceutics, 526(1-2), pp.125-136.
4. Zhao, X., Birchall, J., Coulman, S., Tatovic, D., Singh, R., Wen, L., Susan Wong, F., Dayan, C. and Hanna, S. (2016). Microneedle delivery of autoantigen for immunotherapy in type 1 diabetes. Journal of Controlled Release, 223, pp.178-187.
5. Ling, Ming-Hung, and Mei-Chin Chen. "Dissolving Polymer Microneedle Patches For Rapid And Efficient Transdermal Delivery Of Insulin To Diabetic Rats". Acta Biomaterialia 9.11 (2013): 8952-8961.

Biography

Radeyah Ali is a highly motivated PhD student in my second year of research working in drug delivery. I have made rapid progress in my research through hard work and determination. I have successfully completed a comprehensive literature review which will be written up for a publication specific to my research as well as carrying out experiments. I have carried out laboratory demonstrations aiding students in their practical and written work during a practical session.

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