Intradermal delivery of nanoparticulate vaccines using coated and hollow microneedles

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Propositions

1. To enable efficient coating of nanoparticles onto pyridine-modified microneedles, the nanoparticles should have a negative surface charge and a good colloidal stability.

This thesis, Chapter 2

2. Co-encapsulation of ovalbumin and poly(I:C) in nanoparticles modulates the immune response towards a Th1 direction following intradermal vaccination.

This thesis, Chapter 4

3. The in-house developed hollow microneedle/applicator system is an excellent tool to screen formulations for intradermal vaccination.

This thesis, Chapter 4

4. The aggregation of nanoparticles after being released from coated microneedles into skin leads to suboptimal immune responses.

This thesis, Chapter 6

5. Developing the next generation of vaccines will be increasingly challenging.

Greenwood et al., Phil. Trans. R. Soc. B (369) 2013.

6. Cationic liposomes are the most effective liposomal delivery systems for vaccine antigens.

Christensen et al., Expert. Rev. Vaccines (10) 2011.

7. The interest in combining microneedle and nanoparticulate vaccine technologies will continue to grow with the emergence of new types of nanoparticles and new methods to fabricate microneedles.

Larraneta et al., Pharm. Res. (33) 2016.

8. The ultimate measure of the impact of microneedles is their translation into use in clinical medicine to benefit patients.

Prausnitz. Annu. Rev. Chem. Biomol. Eng. (8) 2017.

9. If you don't have perseverance, you cannot achieve anything.

–Adapted from Guofan Zeng's diary and family letter

10. If you have a lemon, make lemonade.

- Adapted from Dale Carnegie: How to stop worrying and start living

11. Tell me and I forget. Teach me and I remember. Involve me and I learn.

-Adapted from Biography of Benjamin Franklin