

Electrospinning and spraying of biomolecules and cell-derived bodies

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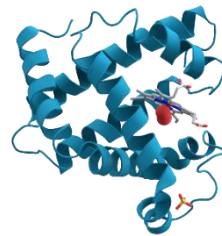
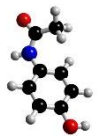
What can we electrospin?

Mass (g)

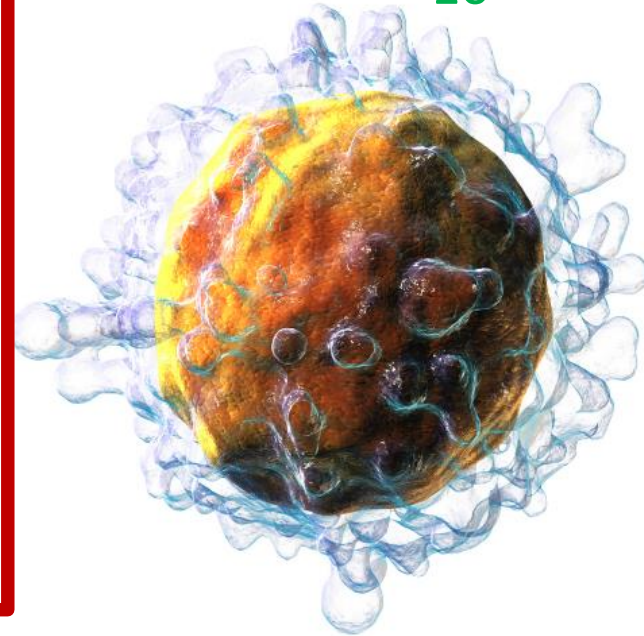
10^{-22}

10^{-9}

Peptides



Extracellular vesicles



Proteins

Cells

Small molecules

Number of publications

100s

10s

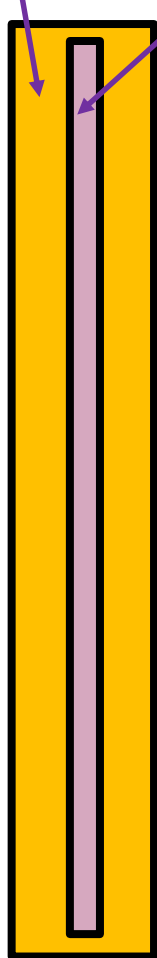
0!!

1s

Protein delivery to the eye

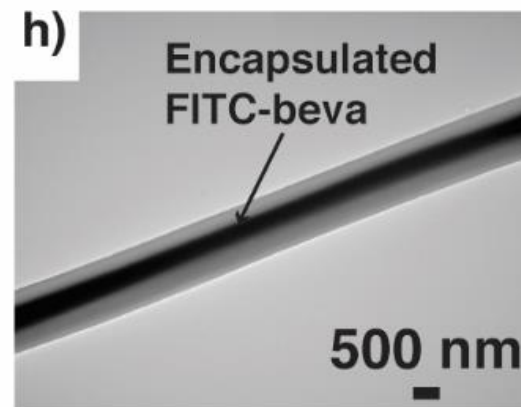
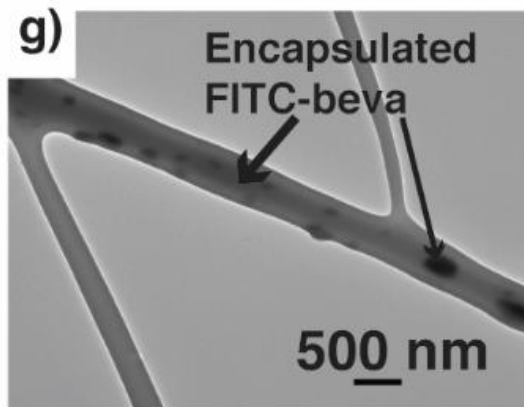
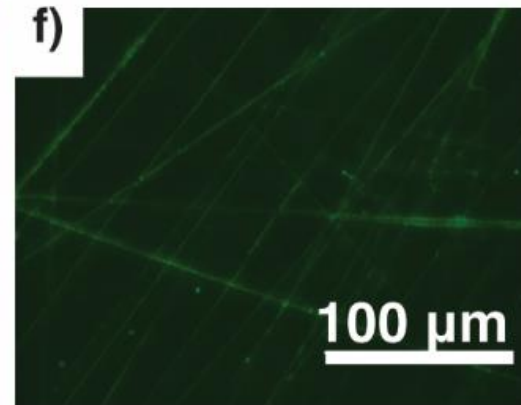
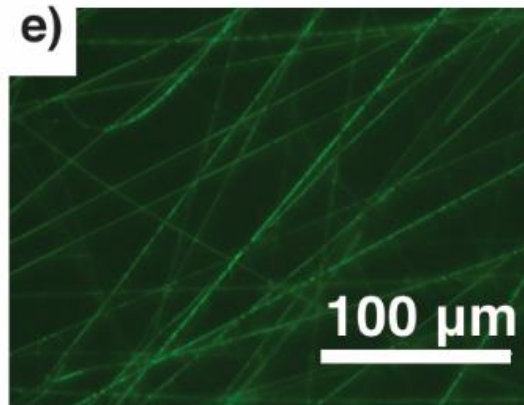
Core/shell bevacizumab loaded fibers

PCL Beva solution in PBS, buffered at:

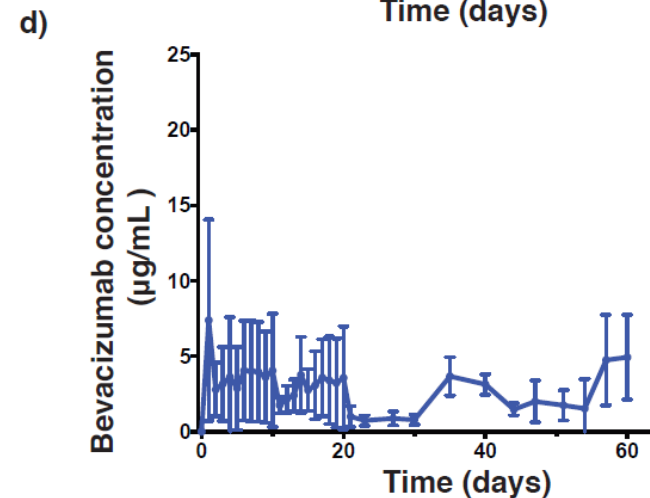
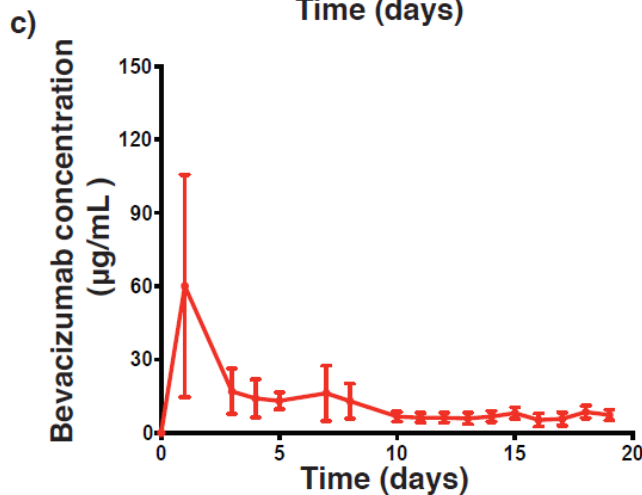
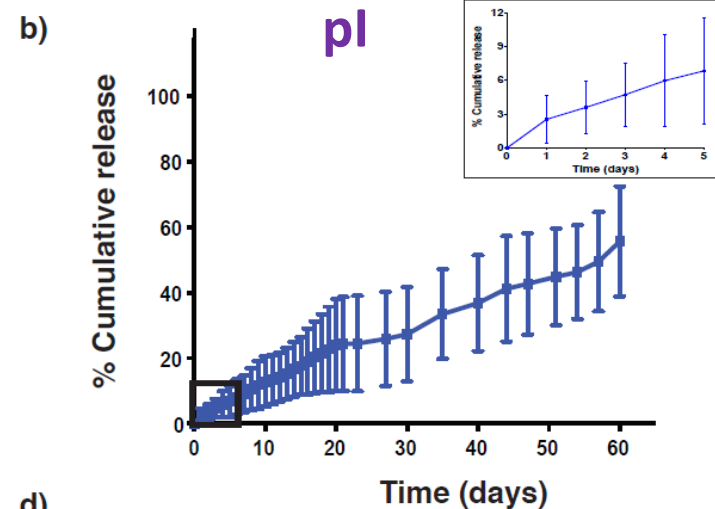
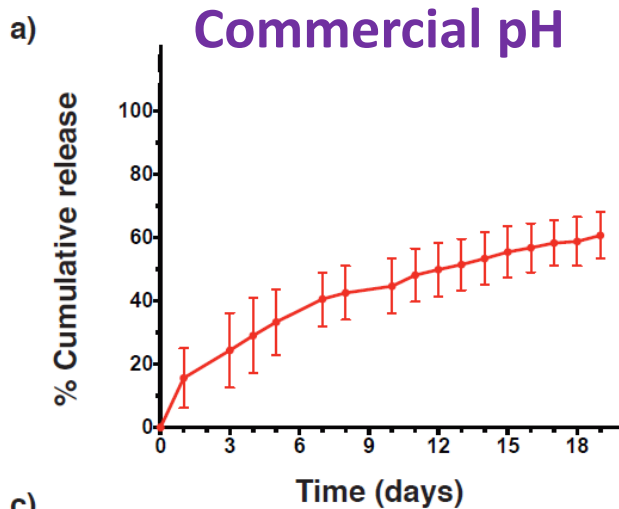


Commercial pH

pI

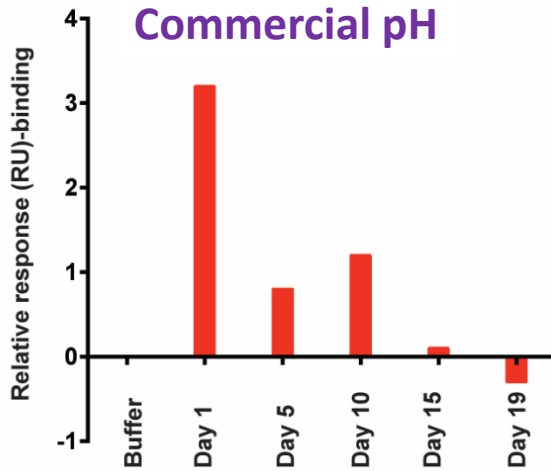


Drug release in an *in vitro* eye model

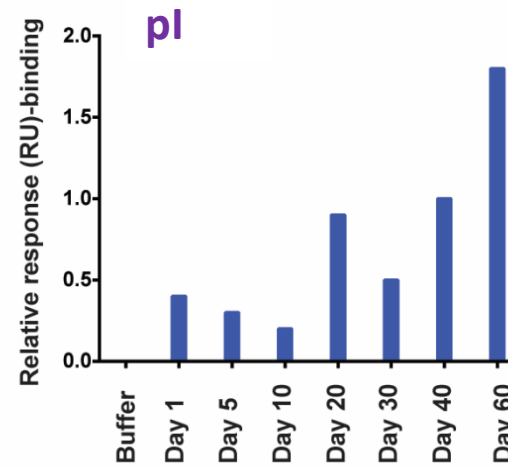


Protein integrity and binding

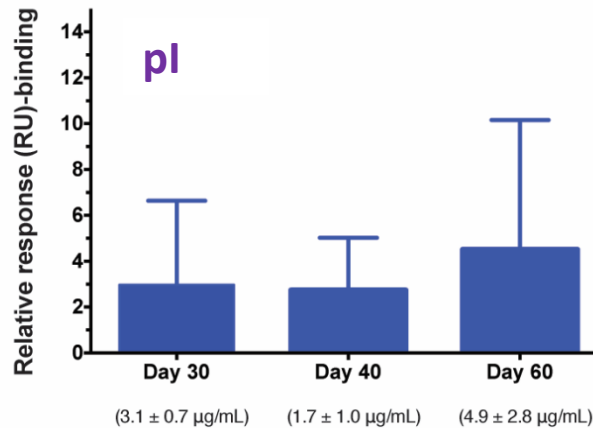
a)



b)

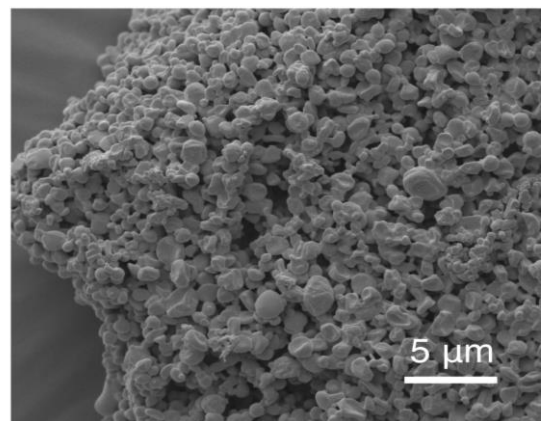
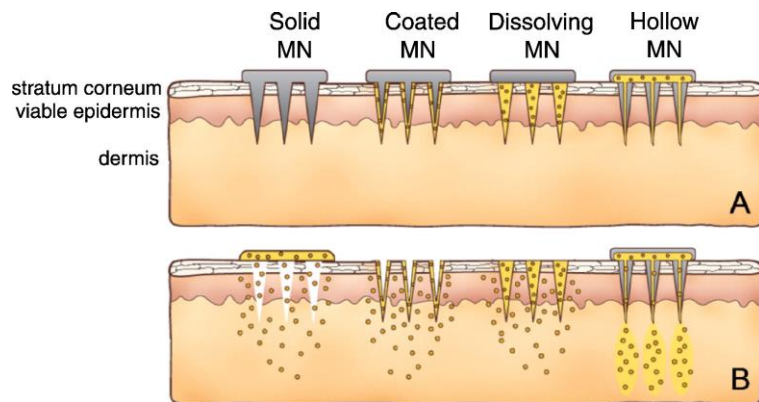


c)

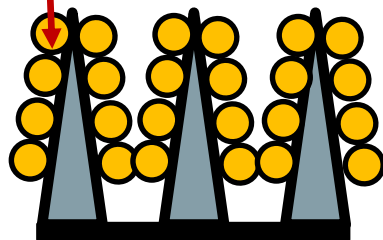


Intradermal protein delivery

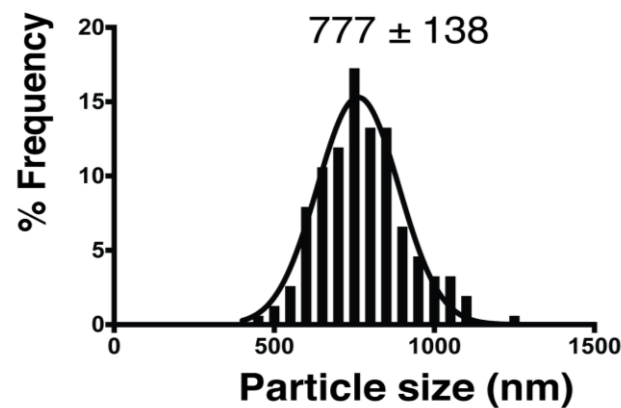
Microneedles + electrosprayed particles?



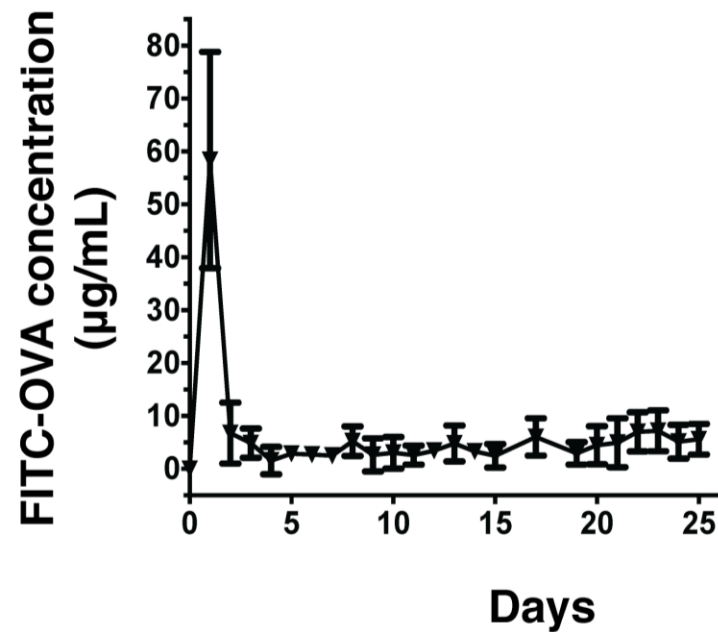
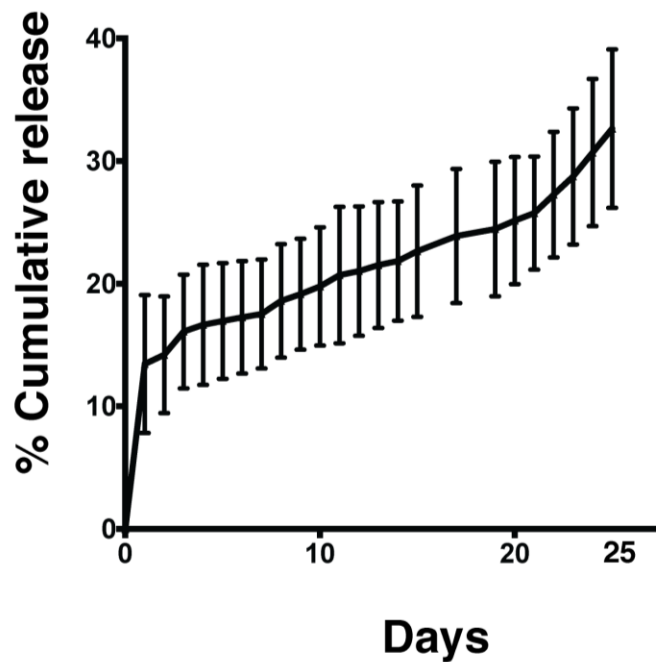
PLGA-OVA microparticles



Swellable hydrogel-forming MNs

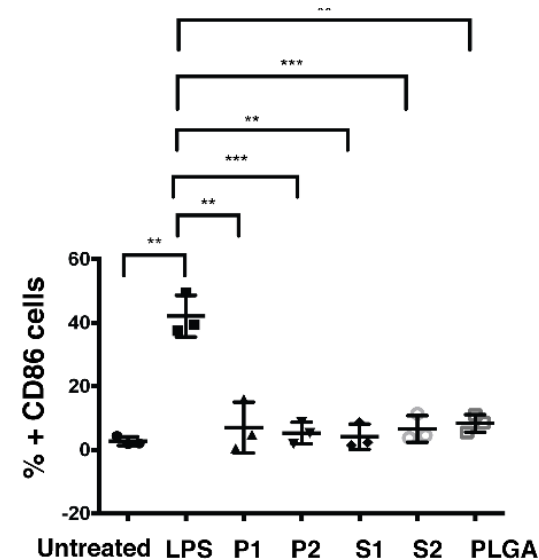
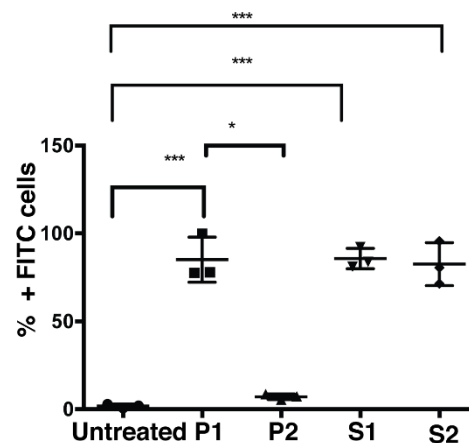
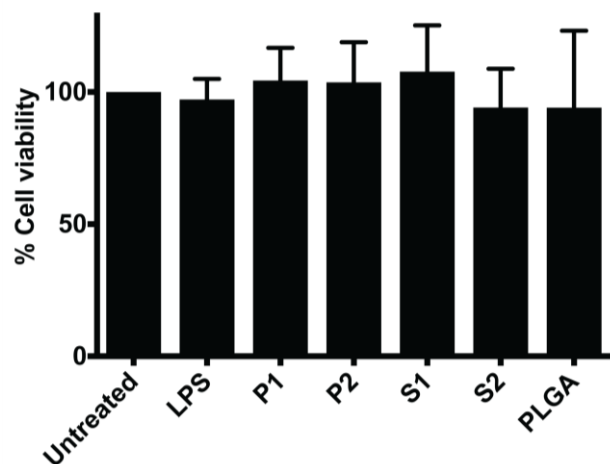


OVA release

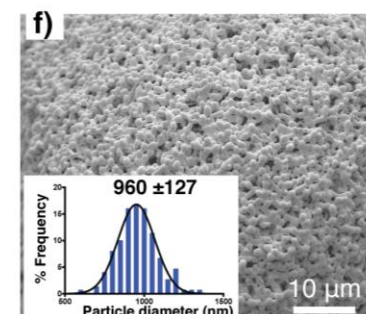
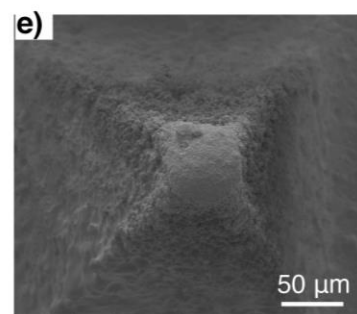
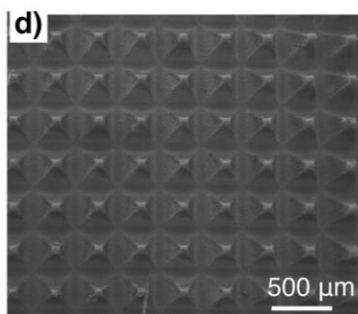
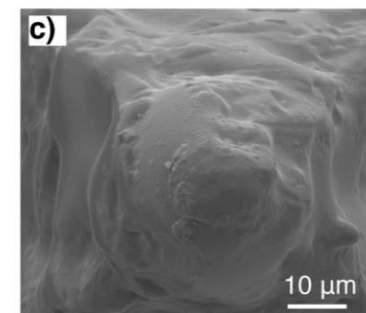
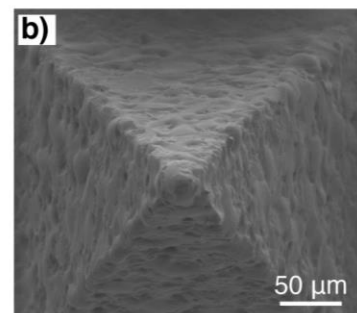
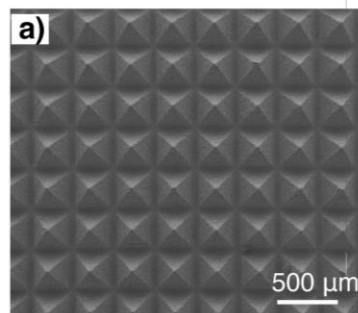
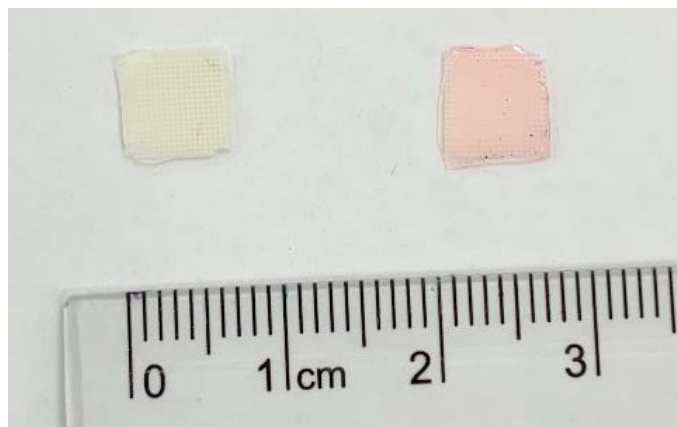


Immunogenicity *in vitro*

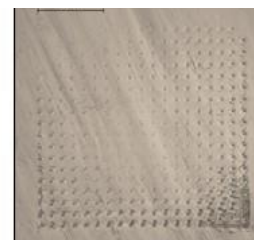
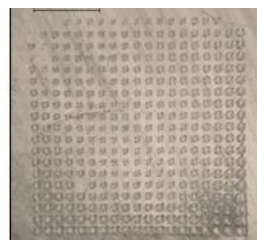
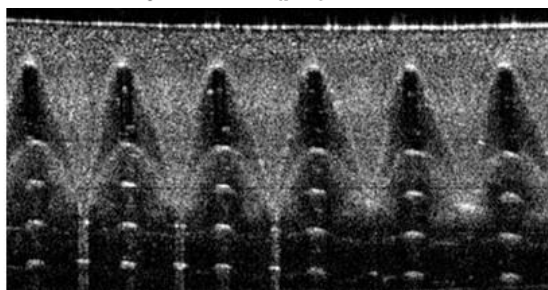
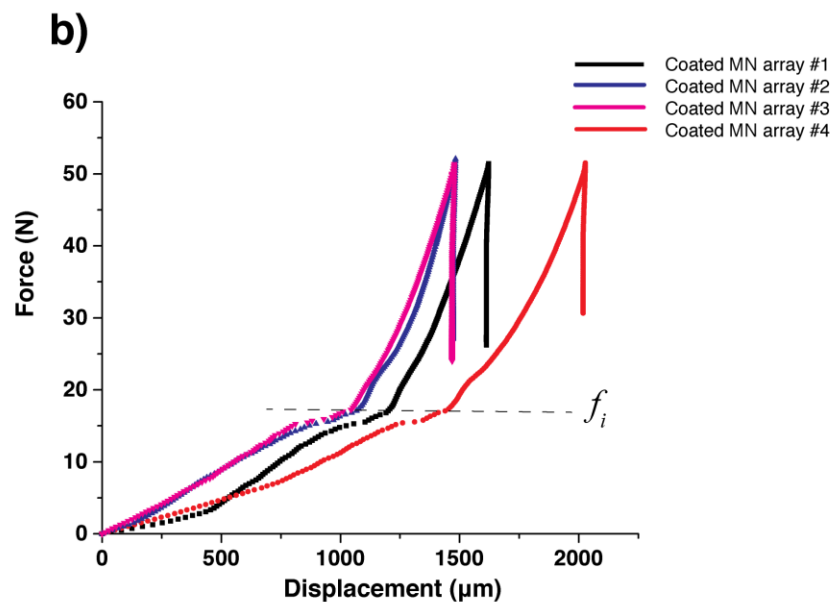
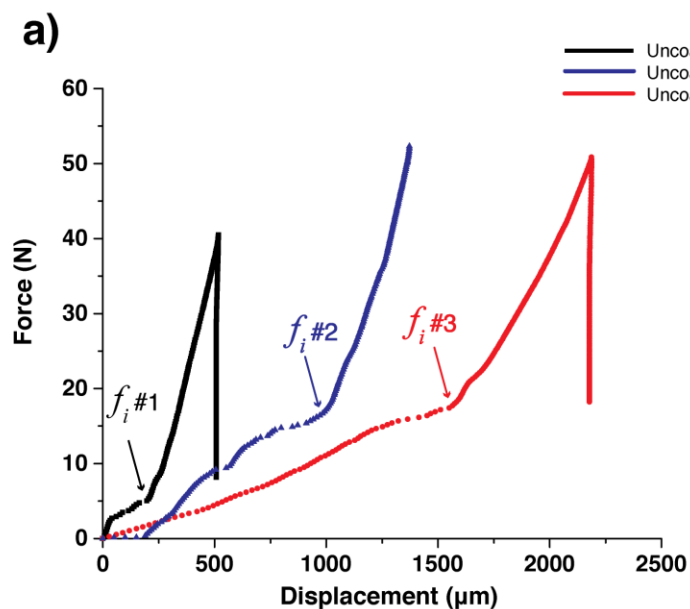
Human monocyte-derived dendritic cell data



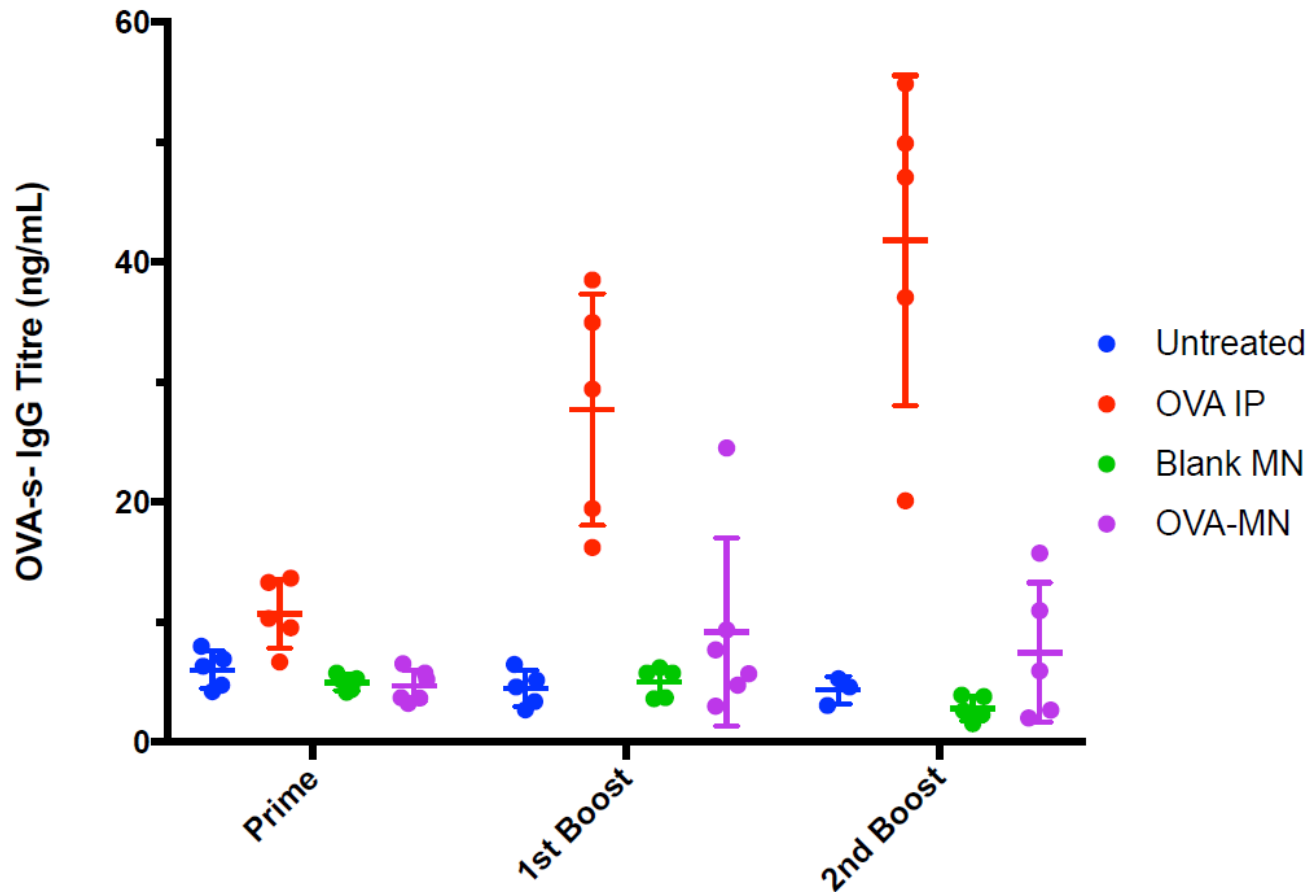
Coating



Coating

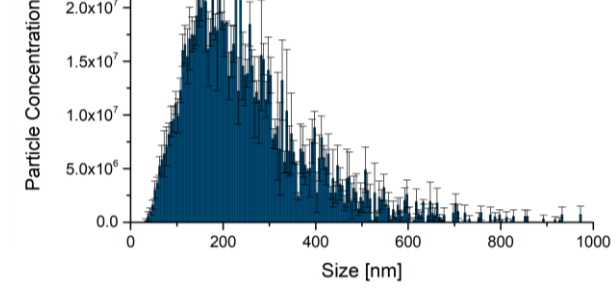
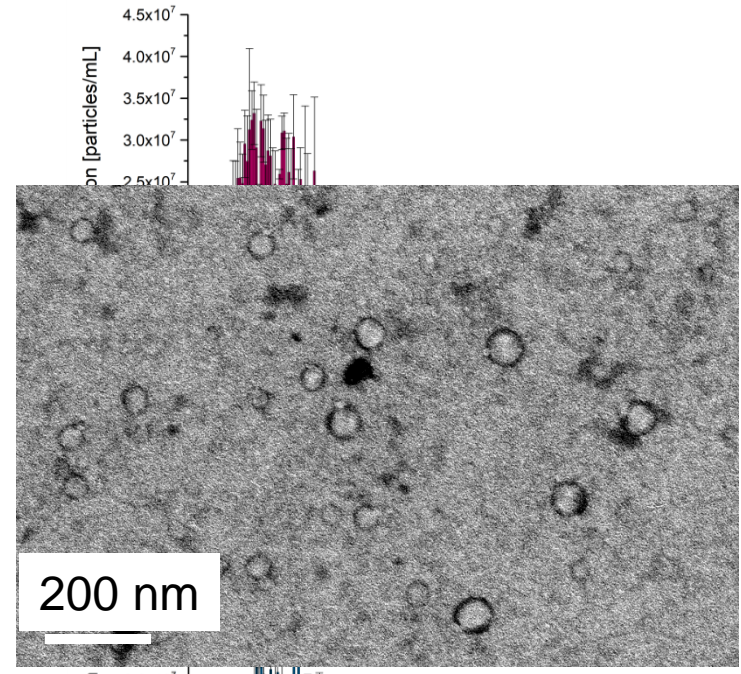
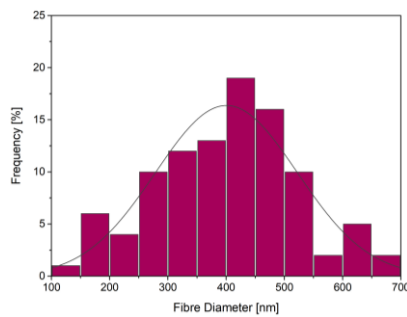
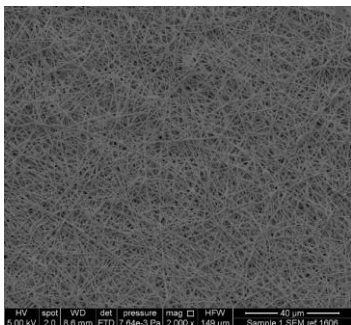
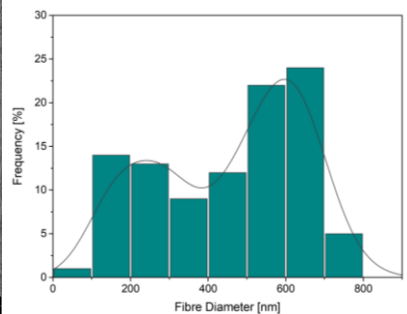
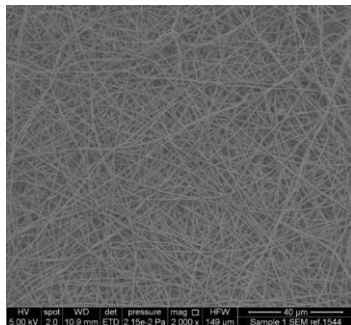
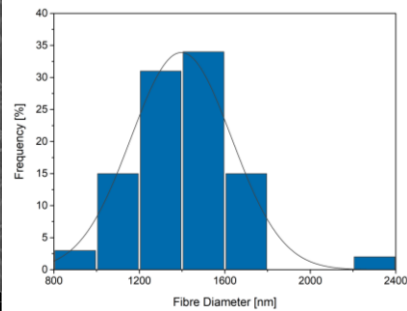
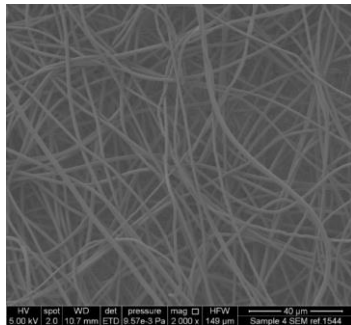


In vivo immunogenicity?

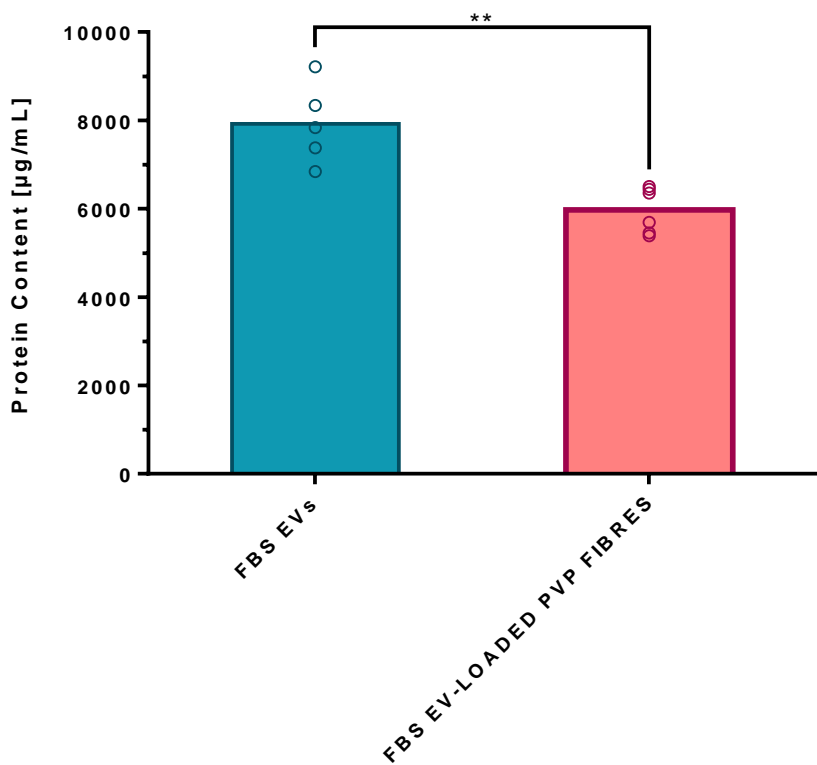


So can we electrospin extracellular vesicles?

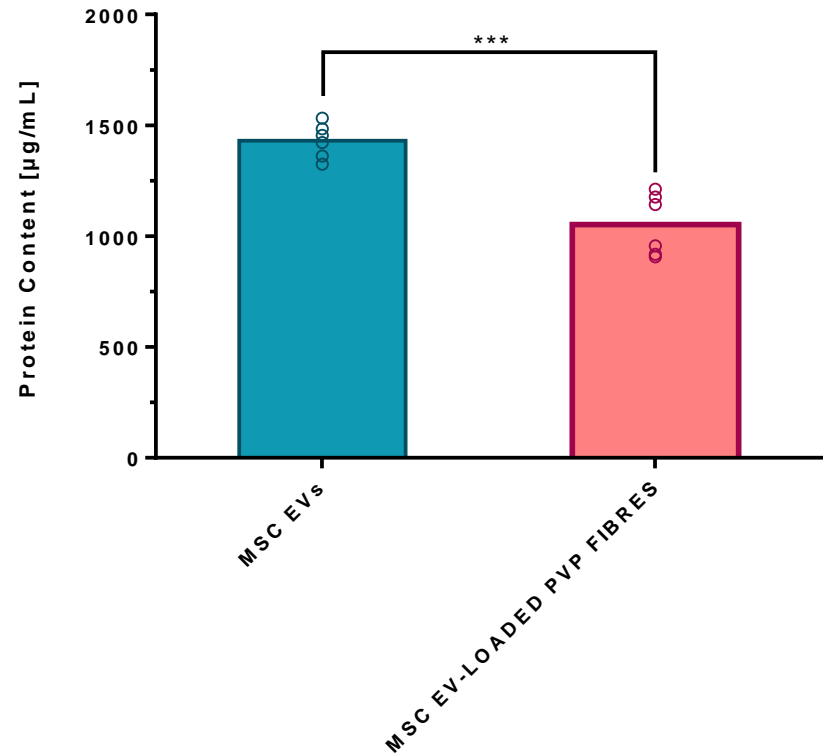
EV-loaded fibers



What happens to the EVs?

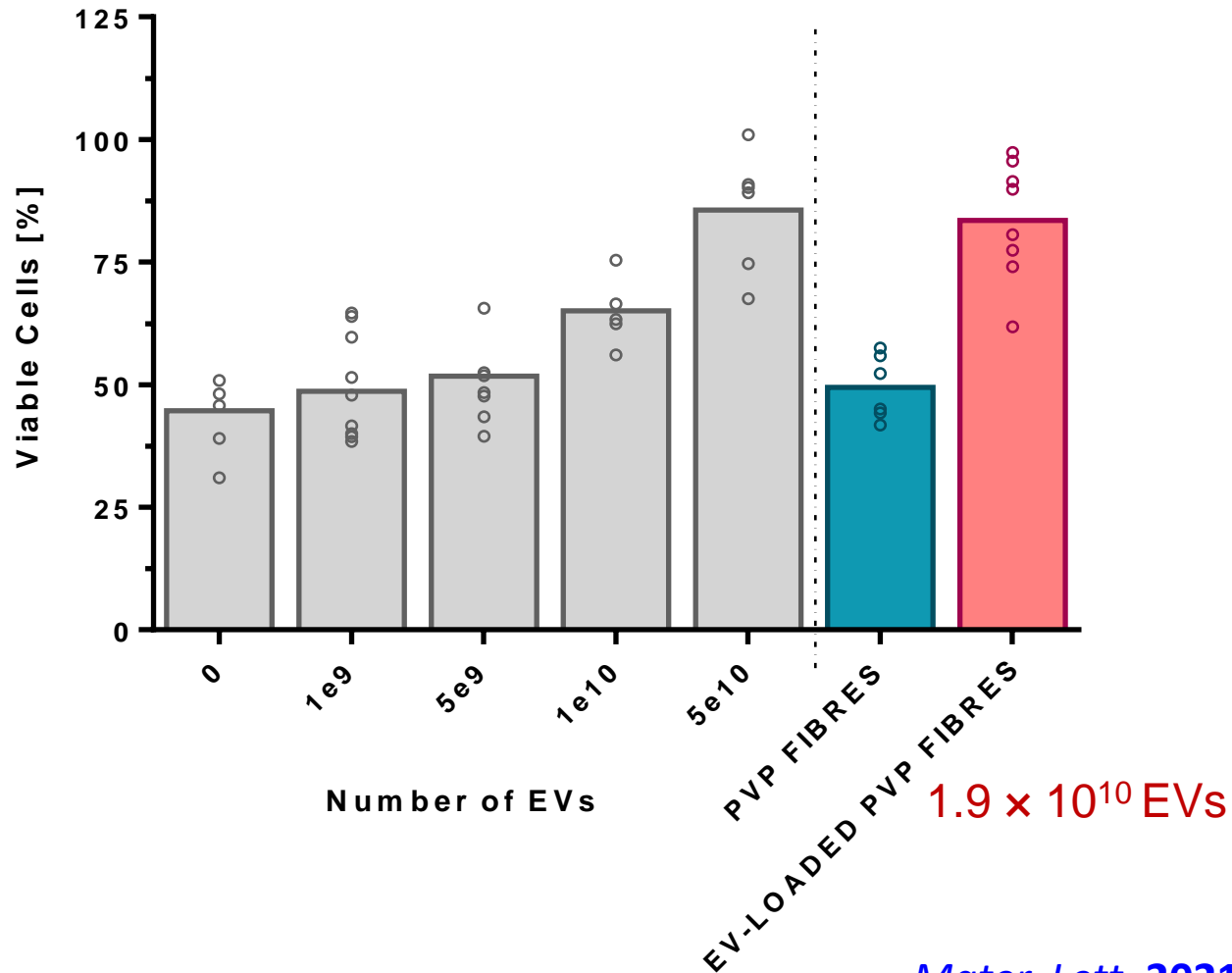


EE $77 \pm 2 \%$



EE $71 \pm 9 \%$

What happens to the EVs?



Conclusions

- Electrospinning/spraying can be used to produce polymer nanofibers/particles loaded with a range of active pharmaceutical ingredients.
- This includes proteins for the treatment of diseases in the eye or for intradermal implantation.
- In both cases we can make minimally invasive implants to give zero-order release over a prolonged time period.
- Extracellular vesicles can also be processed without any damage to their structure or function.

Acknowledgements

UCL:

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Prof Helen McCarthy

Dr Eneko Larraneta

Dr Aaron Courtenay

Dr Aoife Rodgers

EPSRC

Engineering and Physical Sciences
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