# Development and characterisation of a library of dissolving polymeric microneedles for targeted drug delivery for basal cell carcinoma


Akmal Sabri[1], Zachary Cater[2], Pratik Gurnani[1], .John McKenna[2], Jane Ogilvie[3], Joel Segal [2], David Scurr[1], Maria Marlow[1]

[1]School of Pharmacy, The University of Nottingham, NG7 2RD, Nottingham, UK

[2]Department of Mechanical, Materials and Manufacturing Engineering, Faculty of Engineering, University of Nottingham, Nottingham, NG8 1BB

[3] Walgreens Boots Alliance, Thane Road, Nottingham, NG90 1BS

[4] Leicester Royal Infirmary University Hospitals Leicester Dermatology Department, Infirmary Square, Leicester LE1 5WW


University of Nottingham UK | CHINA | MALAYSIA

## Introduction

- Basal cell carcinoma, BCC (Fig. 1) is the most common skin cancer in humans with the highest incidence rate in people with fair skin.
- Imiquimod is one of the most efficacious drugs used in the management of BCC is imiquimod (Fig 2). However, imiquimod has physiochemical properties that limit permeation and access to deeper tumour lesions.
- One strategy to assist the delivery of imiquimod to deeper BCC lesions is through the use of dissolving polymeric microneedles, (Fig. 3).

***Figure 1:*** Facial basal cell carcinoma

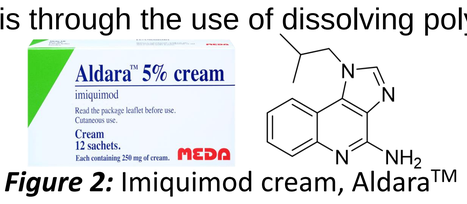



***Figure 2:*** Imiquimod cream, Aldara™

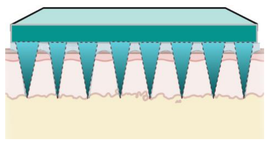
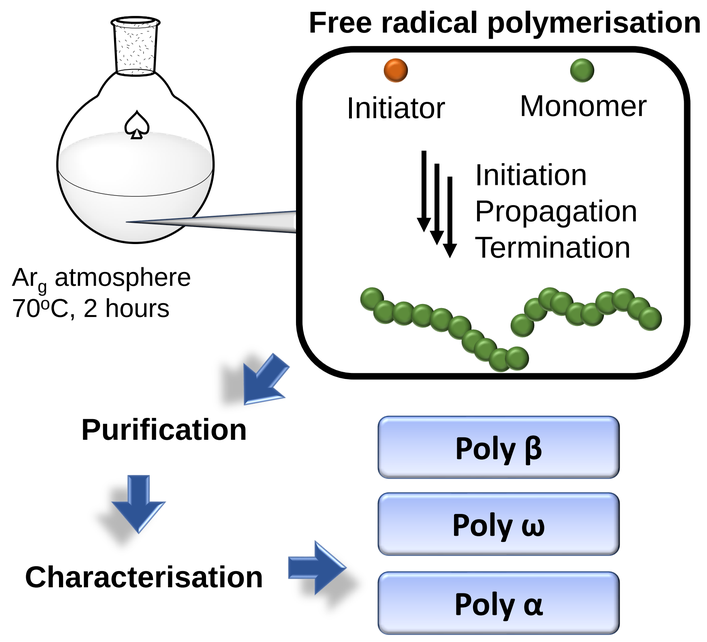


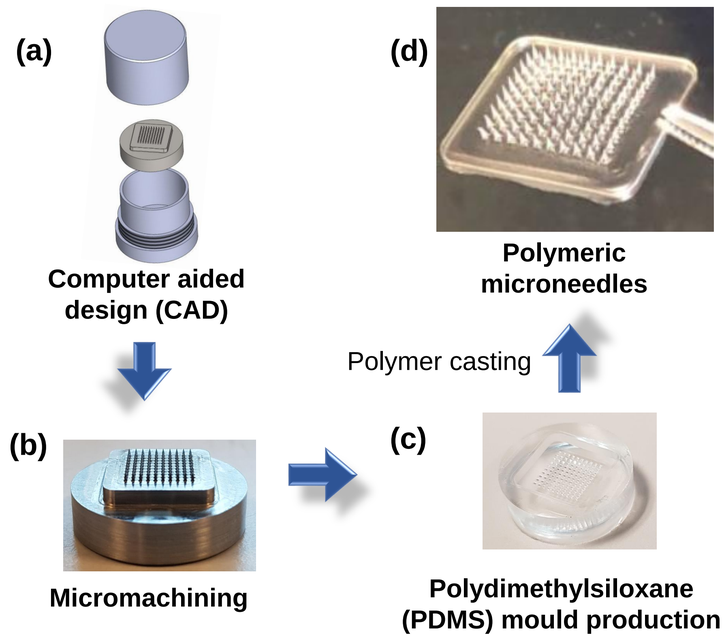
***Figure 3:*** Polymeric microneedle patches.

## Methodology

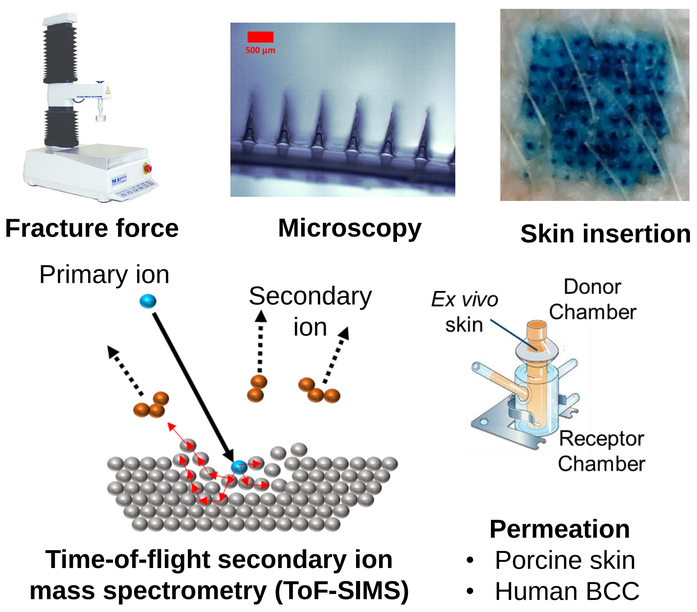
### Polymer Synthesis




### Microneedle Fabrication




### Characterisation and Evaluation

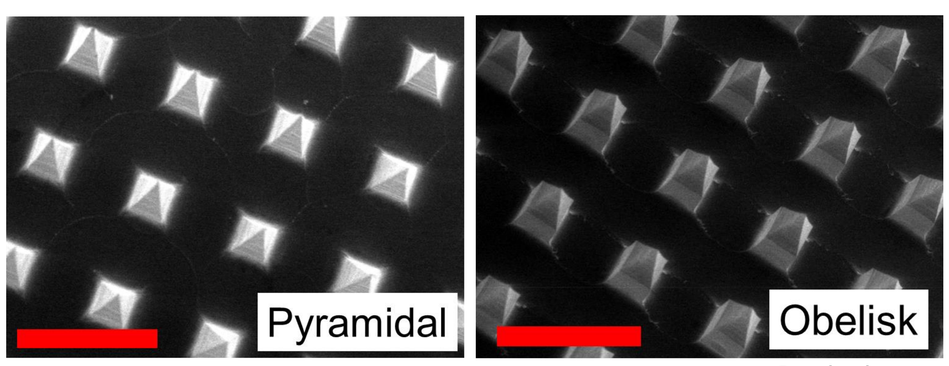



## Results

### Polymer Characterisation

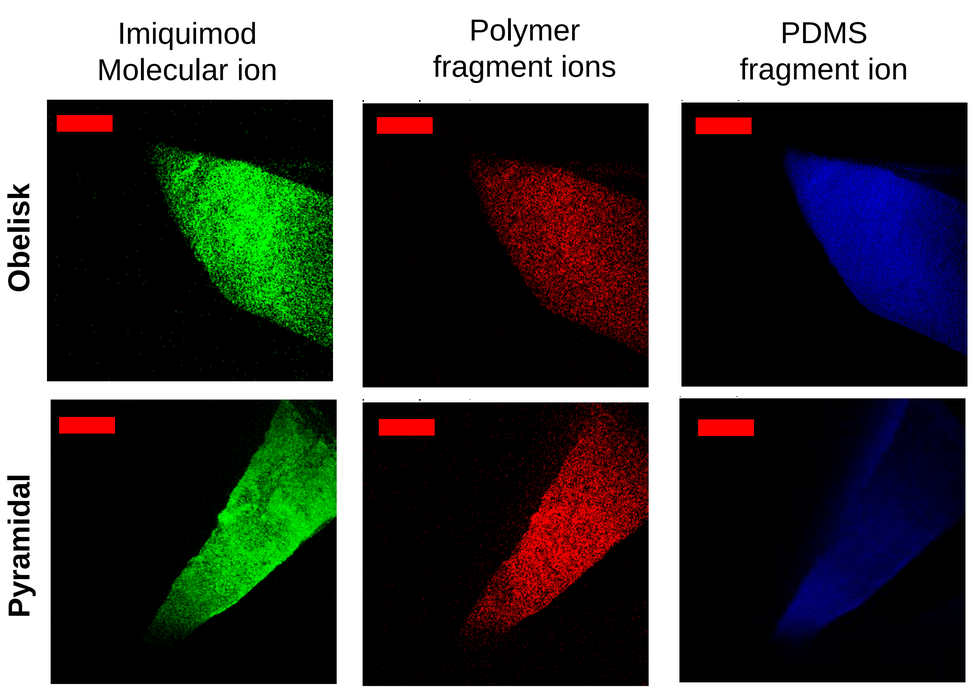
| Polymers | $M_{n,SEC}$ (g mol$^{-1}$) | Glass transition temperature, Tg, °C |
|---|---|---|
| PVPVA | 16, 900 | 106 |
| Poly ω | 55, 800 | 117 |
| Poly β | 126, 900 | 127 |
| Poly α | 43, 700 | >150 |

### Microscopy



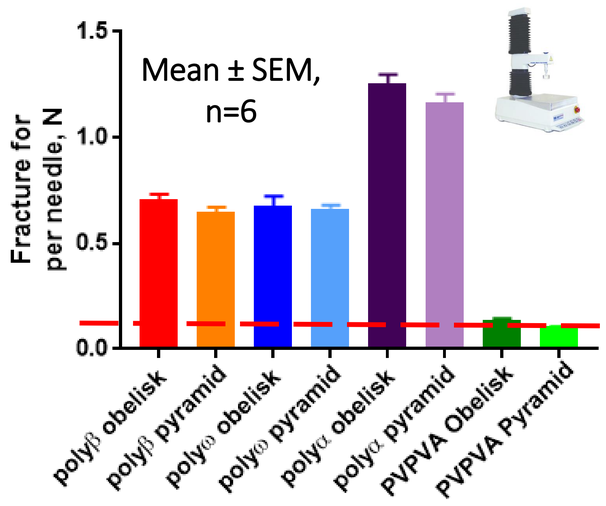

Scale bars 1000 µm

### ToF-SIMS drug and polymer distribution analysis

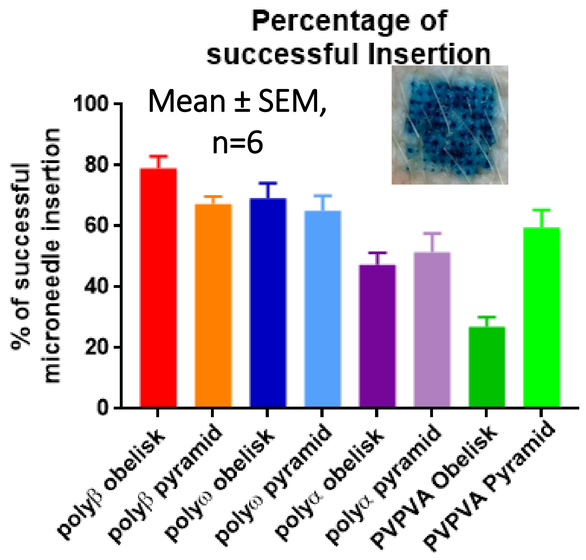



Scale bars 100 µm

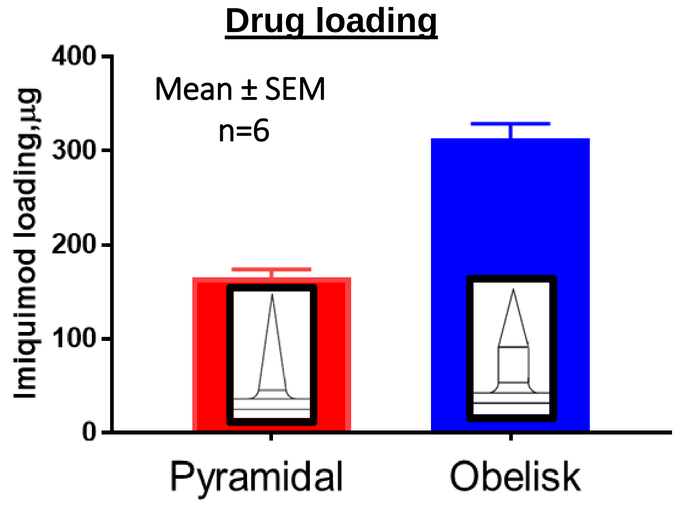
### Mechanical strength



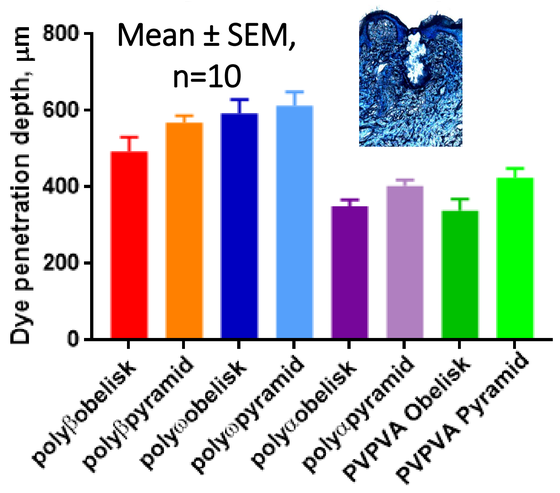

### Skin Insertion Study



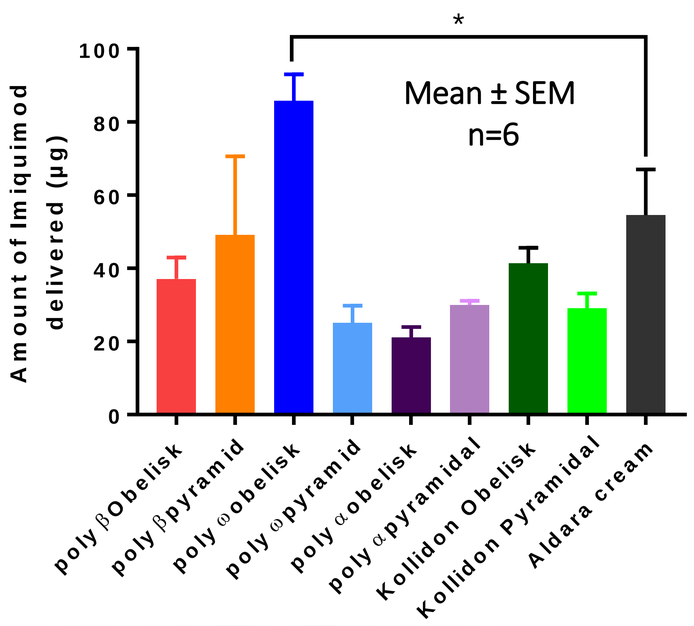

### Drug loading



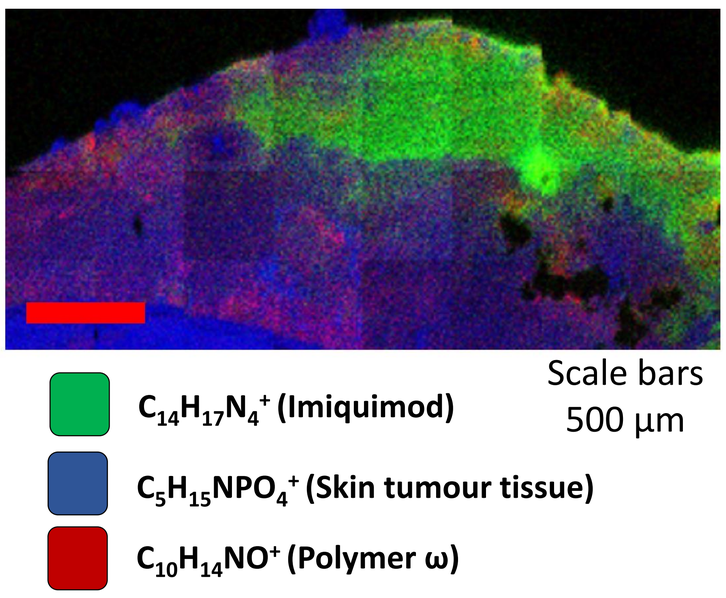

### Dye Penetration Depth




### Intradermal Drug Delivered into porcine skin




### ToF-SIMS human BCC dermal drug and polymer distribution analysis




Scale bars 500 µm

## Conclusion

- Eight dissolving polymeric microneedles were formulated and characterised.
- Drug and polymer distribution were homogenously distributed along microneedle length.
- Formulating imiquimod into dissolving microneedle enhanced imiquimod permeation into the skin as demonstrated using *ex vivo* porcine skin and human BCC tumour as compared to commercial cream Aldara™ (5% w/w imiquimod).

## Acknowledgements


Walgreens Boots Alliance

CDT in Advanced Therapeutics and Nanomedicines

EPSRC Engineering and Physical Sciences Research Council