Biomaterials Science



EDITORIAL

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Introduction to microneedles

rather than a healthcare worker, provides

opportunities for home care, increasing

patient convenience and reduced costs

for healthcare providers. While the MN

field developed fairly slowly after the

publication of the first academic paper

in ref. 1, recent progress has been brisk.

Extensive clinical trials are currently

underway and manufacture has moved

out of university laboratories and into

contract manufacturing organisations'

ments. The ref. 2 organisation has

brought together MN developers, manu-

facturers, regulatory authorities and

pharmacopoeial experts through their

Centre of Excellence for Microarray

Patches with a view to accelerating trans-

lational development and speeding up

access for patients. While the first MN

products to make it to market are likely

to be fairly simple formulations based

on existing pharmaceutical excipients,

the next generation of products may be

environ-

good-manufacturing-practice

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Microneedle arrays (MN) are minimallyinvasive devices that painlessly, and without drawing blood, by-pass the skin's stratum corneum barrier, thus allowing deposition of materials in the viable skin layers. MN (50-900 μm in height, up to 10 000 MN cm⁻²) of geometries and (silicon, metal, polymer) are produced using microfabrication. Polymeric MN release their drug payload as they swell, dissolve or biodegrade in the viable skin layers. In vivo studies using MN have demonstrated delivery of oligonucleotides, hormones and other potent substances, reduction of blood glucose levels from insulin delivery and increase of skin transfection with DNA. However. the vast majority of work in this field has historically been concentrated on intradermal vaccine delivery. This is hardly surprising, given the potential for stable, dry-state formulation, the avoidance of needle-stick injuries common with hypodermic syringes, dose-sparing through direct targeting of viable skin's abundance of specialised antigen-presenting cells and the self-disabling nature of dissolving MN. Increasingly, however, researchers in academia and industry are exploring MN as a means for drug delivery, biosensing and wound management, amongst a plethora of other applications. That MN can be applied to skin by patients themselves,

based on more complex or stimuliresponsive systems. It is on this cutting edge of the field that this collection is based. MN show great promise as blood-free biosensors with a wide variety of applications. The review of Wang et al. (https://doi.org/10.1039/D3BM00463E) discusses progress made in glucose biosensing, while the experimental paper of Deng et al. (https://doi.org/10.1039/ D3BM00780D) presents novel approaches to demand-based drug delivery; Li et al. (https://doi.org/10.1039/ D2TB02142K) study cholesterol measure-

ment, while Ajmal Mokhtar et al.

The experimental papers of Wang et al. (https://doi.org/10.1039/D2BM01836E), Jiang et al. (https://doi.org/10.1039/D2BM01937J) and Anjani et al. (https://doi.org/10.1039/D2BM01068B), as well as the review of Zheng et al. (https://doi.org/10.1039/D3TB01441J), all describe novel MN-based approaches to management of gout and other musculoskeletal conditions.

Advanced materials are often defined as those that are specifically engineered or synthesised to exhibit novel or enhanced properties that confer superior performance relative to conventional materials. In drug delivery and biosensing, advanced materials are often combinations of several conventional or newly synthesised substances, often polymers. The reviews of Malek-Khatabi et al. (https://doi.org/10.1039/D3BM00795B) and Zhang et al. (https://doi.org/10.1039/ D2TB00905F) and the experimental papers of Tobin and Brogden (https:// doi.org/10.1039/D3BM00972F), Chen (https://doi.org/10.1039/ D3BM00182B), Aung et al. (https://doi. org/10.1039/D3BM00132F), Fu et al. (https://doi.org/10.1039/D2TB02613A), Li et al. (https://doi.org/10.1039/D3TB00127J), Zhang et al. (https://doi.org/10.1039/ D2BM02096C), Zhao et al. (https://doi. org/10.1039/D2BM01454H), Abu-Much (https://doi.org/10.1039/

⁽https://doi.org/10.1039/D3TB00485F) demonstrate electrochemical skin sensing and Shi *et al.* (https://doi.org/10.1039/D2TB02600G) use surface-enhanced Raman scattering to observe drug delivered into skin from a MN patch

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D2BM01143C), Unver *et al.* (https://doi.org/10.1039/D2TB01648F) and Li *et al.* (https://doi.org/10.1039/D2BM01275H) all discuss the use of novel advanced materials in MN systems, demonstrating enhanced performance.

Editorial

MN could be used to improve treatment of wounds and scars, as indicated in the review from Zhao *et al.* (https://doi.org/10.1039/D3BM00262D) and the experimental papers of Hu *et al.* (https://doi.org/10.1039/D2TB02596E), Cai *et al.*

(https://doi.org/10.1039/D2BM02101C), Gao *et al.* (https://doi.org/10.1039/D2BM01588A) and Huang *et al.* (https://doi.org/10.1039/D2BM01631A). Nesovic *et al.* (https://doi.org/10.1039/D3BM00305A) and Lee *et al.* (https://doi.org/10.1039/D3BM00377A) describe novel approaches to MN vaccination.

We believe that these exciting studies demonstrate considerable progress in the microneedle field and we hope that you enjoy reading through the collection.

References

- 1 S. Henry, D. V. McAllister, M. G. Allen and M. R. Prausnitz, Microfabricated microneedles: a novel approach to transdermal drug delivery, *J. Pharm. Sci.*, 1998, 87, 922–925.
- 2 PATH. Centre of Excellence for Microarray Patches. https://www.path.org/resources/path-center-excellence-microarray-patch-technology/, accessed 24th August 2023.