Microneedle patch array for point-of-care medicine

Background

We have developed a novel open-channel microneedle patch to address the clinical need for unskilled, painless collection of blood or transcutaneous delivery of pharmaceuticals. Skin is penetrated by ultra-sharp grooved microneedles that introduce microfluidic channels across the skin. The patch has a microfluidic network connected to microneedle channels for molecular analysis or drug delivery. The microneedle patch is passively filled by capillary action. This technology will allow soldiers to perform blood diagnostics and administer drugs rapidly across the skin in combat or disaster relief situations.

The field has focused on manufacture of microneedles that penetrate the superficial capillary plexus estimated to be at a depth of at least 600 microns.

Research Goals

- Optimal microneedle designs for painless blood collection and drug delivery
- Scale-out manufacture of microneedle arrays
- Integration of microneedle with microfluidics for molecular analysis or drug delivery

Manufacturing Process

<table>
<thead>
<tr>
<th>3D laser lithography</th>
<th>Prototype mould</th>
<th>Elastomeric negative mould</th>
<th>Thermoplastic replicas</th>
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<td>Nanoscribe GmbH</td>
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2. Romar Engineering Pty Ltd
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Submicron resolution 3D printing directly from CAD drawings (SEM*)

High fidelity replication of thermoplastic microneedles (SEM)

Passive filling by capillary tension

Drug delivery

Delivery of fluorescein into skin
Penetration of skin (confocal microscopy)
Microneedle array after skin penetration
Disposal (no sharps)

\* SEM Scanning Electron Micrographs