Electronic Supplementary Information (ESI)

Implantable Polymeric Microneedles with a Phototriggerable Property as a Patient-Controlled Transdermal Analgesia System

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EXPERIMENTAL SECTION

Fabrication of Nonimplantable Microneedle (MN) Array System. A nonimplantable composite MN system with PCL supporting arrays was fabricated for studying in vitro drug release. The detailed dimensions of the MN master structure used here was shown in **Figure S1d**. After the PDMS mold was filled with lidocaine-loaded MNs, as described in the **Experimental Section**, a PCL flake was put onto the mold surface and then placed into a vacuum oven set at –70 kPa for overnight in an oven at 70 °C to form the PCL supporting array patch. There is no need of the dissolvable PVA/PVP layer in the nonimplantable system because the MNs should be taken out from the skin for measuring the residual drug after *in vitro* triggered release.

Ethics Statement. All animal protocols and experiments were reviewed and approved by the Institutional Animal Care and Use Committee at National Cheng Kung University, Tainan, Taiwan.

Statistical Analysis. The differences between two groups were analyzed using the one-tailed Student's *t* test by using statistical software (SPSS, Chicago, Ill, USA). Data are presented as the mean ± standard deviation, and a difference with $P < 0.05$ was considered statistically significant.

RESULTS

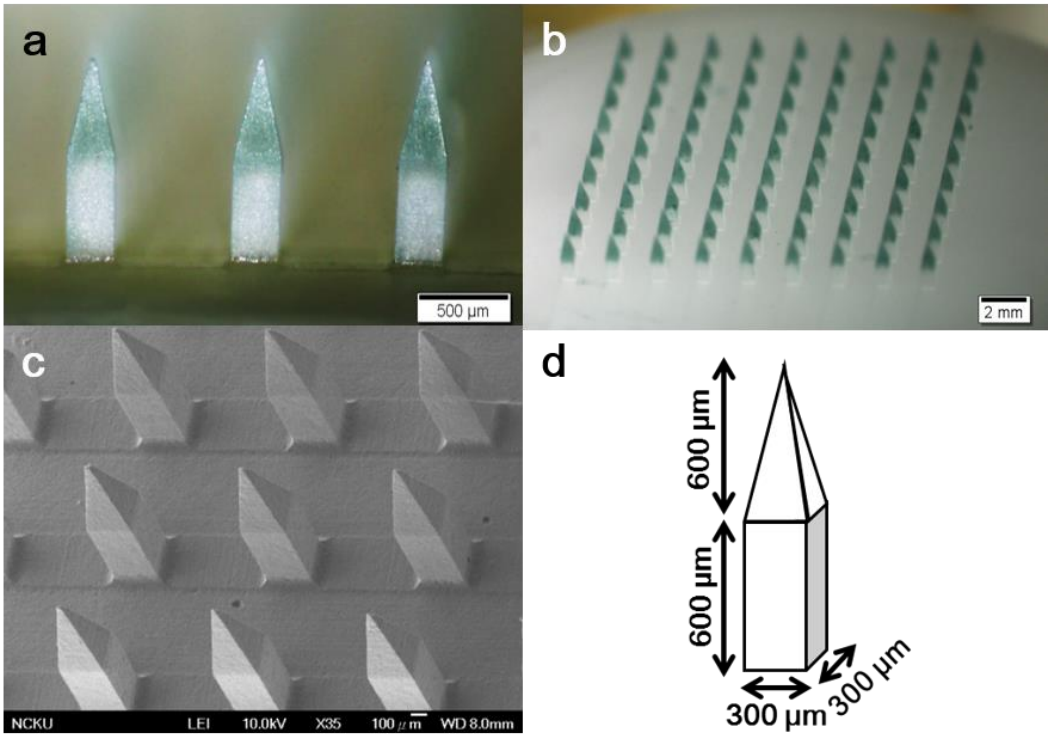

Figure S1. Characterization of nonimplantable MN system. This system consists of lidocaine-loaded polycaprolactone (PCL) MNs and a PCL supporting array patch. Bright-field micrographs (a and b), SEM image (c) and the detailed specifications of the needle (d).

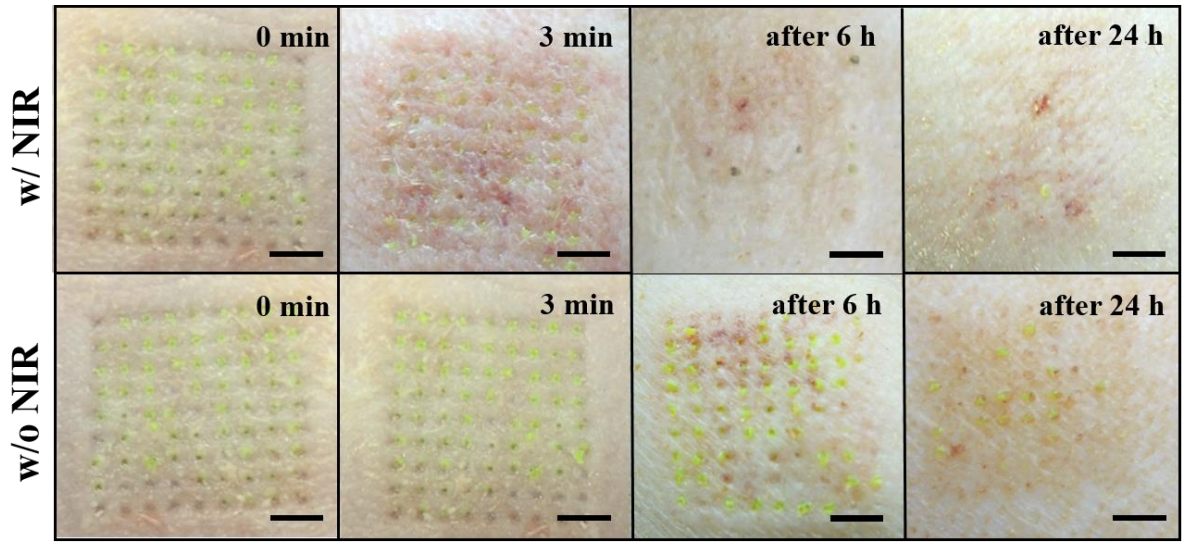

Figure S2. MN thermal effect to the skin. Bright-field micrographs of rat skins after implantation of coumarin 6-loaded MNs and then exposure to a NIR laser (w/ NIR) for 0 and 3 min and at 6 and 24 h after NIR irradiation. w/o NIR: the MN-treated skin without NIR exposure.

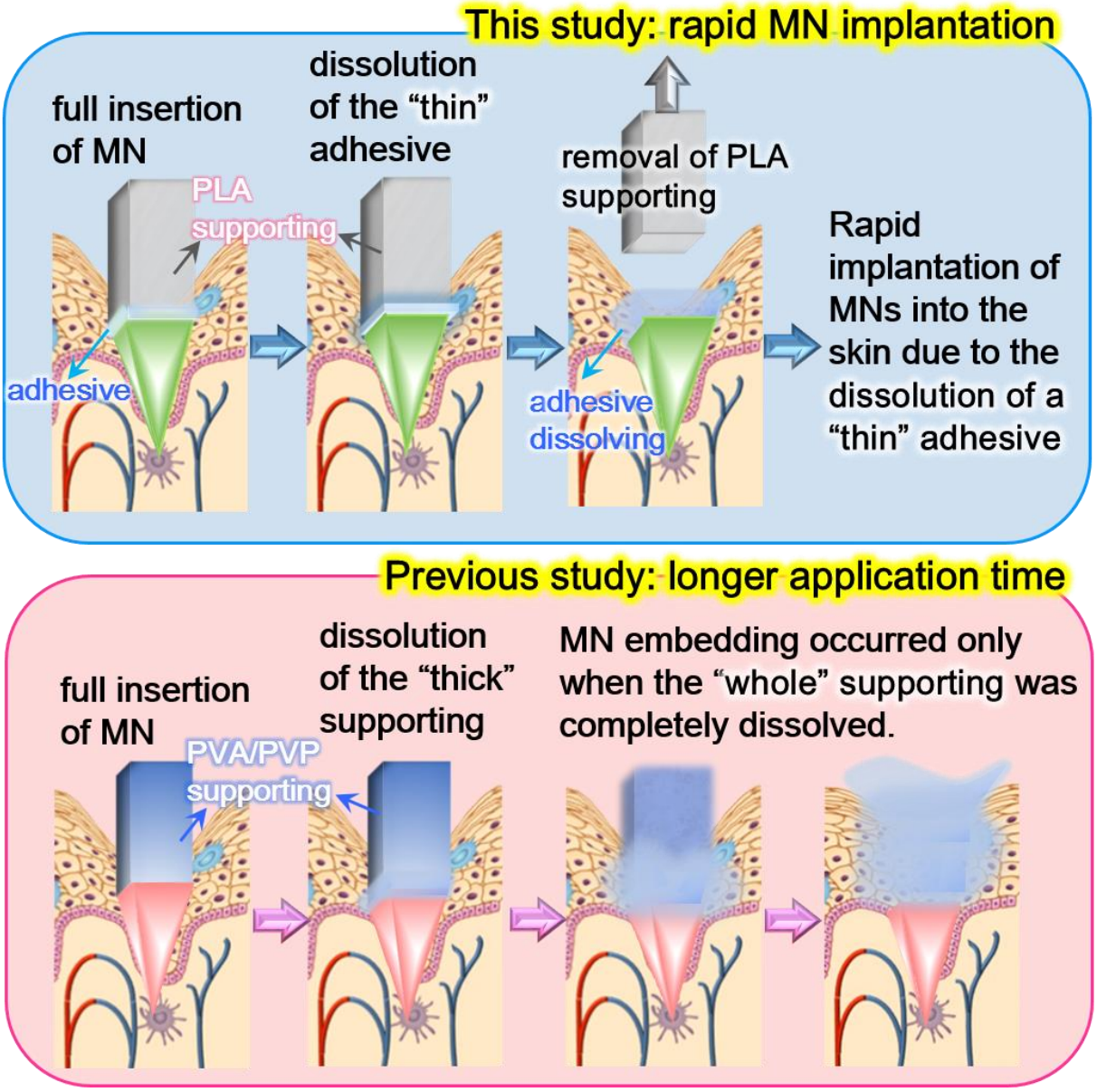

Figure S3. A comparison of the previous (bottom) and the current (top) MN system. In our previous system, MN embedding occurred only when the "whole" PVA/PVP supporting array was completely dissolved in the skin. However, it takes much more time to achieve than the current system because the skin interstitial fluid is limited. The present MN system has a "rapidly removable design" of the supporting array that makes MN implantation become more easy, time-saving and convenient for clinical use.