Electronic Supplementary Information (ESI) for Biomaterials Science

Enhancing cell-scale performance via sustained release of varicella-zoster virus antigen from microneedle patch under simulated microgravity

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Supplementary results

Table S1. Dimension information on the mould that is used to fabricate microneedles.

Pyramid needle				Groove	
Height (μm)	Side length (μm)	Center distance (μm)	Needle array	Side length (mm)	Depth (mm)
670	300×300	500	10×10	9.8×9.8	1.5

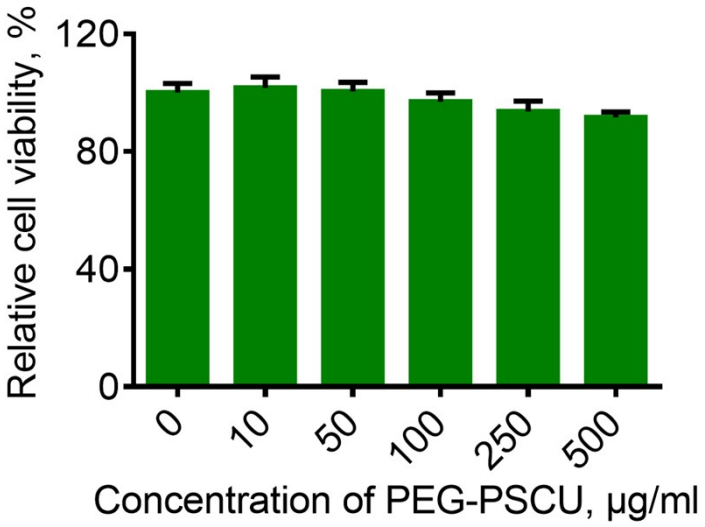


Figure S1. Cytotoxic effects of the PEG-PSCU copolymer at gradient concentrations on dendritic cells *in vitro*. Error bars represent ± SD (n = 3).

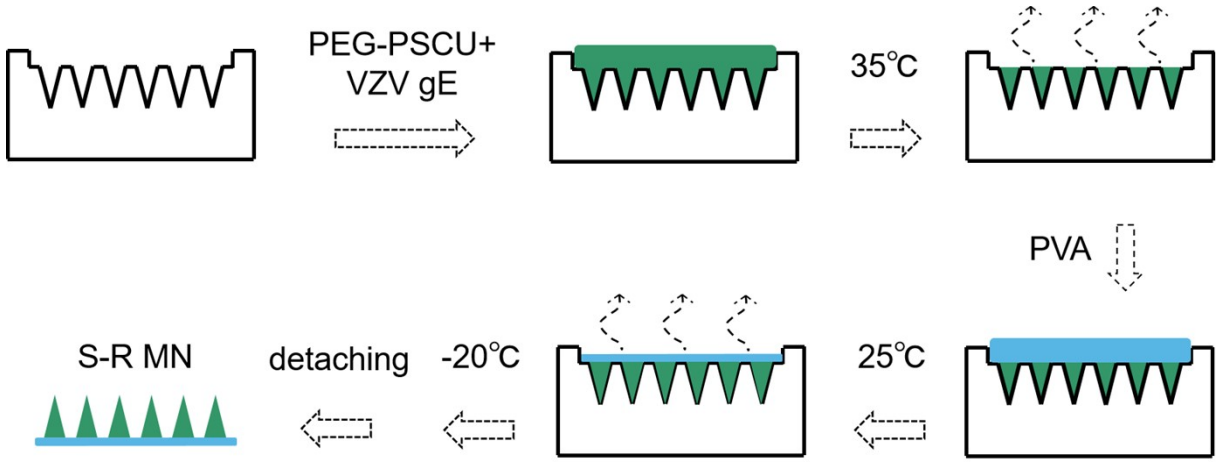


Figure S2. The fabrication process of S-R MN encapsulated VZV gE. The PDMS mold was used to fabricate S-R MN. Initially, 20 wt% of PEG-PSCU solution in pH 8.0 was uniformly mixed with the desired amount of VZV gE and carefully added into all micro-cavities. After removing the bubbles via vacuum evaporation, microneedles were dried at 35℃ for at least 24 h. Thereafter, for the base layer, 15 wt% pure PVA solution was uniformly plated onto the dried needles. Bubbles in this PVA solution were removed via vacuum evaporation, and this base layer solution was dried at room temperature for an additional 12 h and at -20℃ for an additional 12 h to construct a separable S-R MN that could be detached favorably.

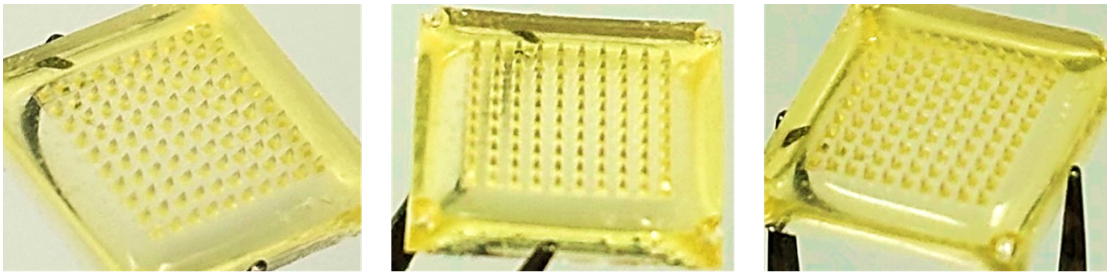
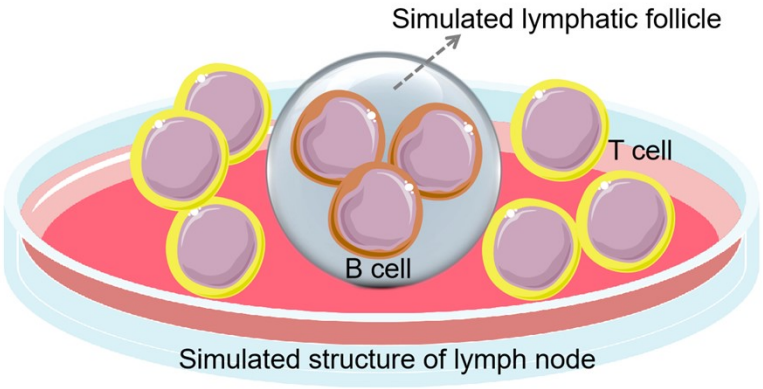


Figure S3. Photographs of an entire original microneedle patch from different angles.

A



B

T cells/ Total cells (%)	CD4⁺T cells/ Total T cells (%)	CD8⁺T cells/ Total T cells (%)	B cells/ Total Simulated lymphatic follicle cells (%)
58.7%±0.4%	46.9%±2.1%	27.3%±2.3%	81.7±1.4%

C

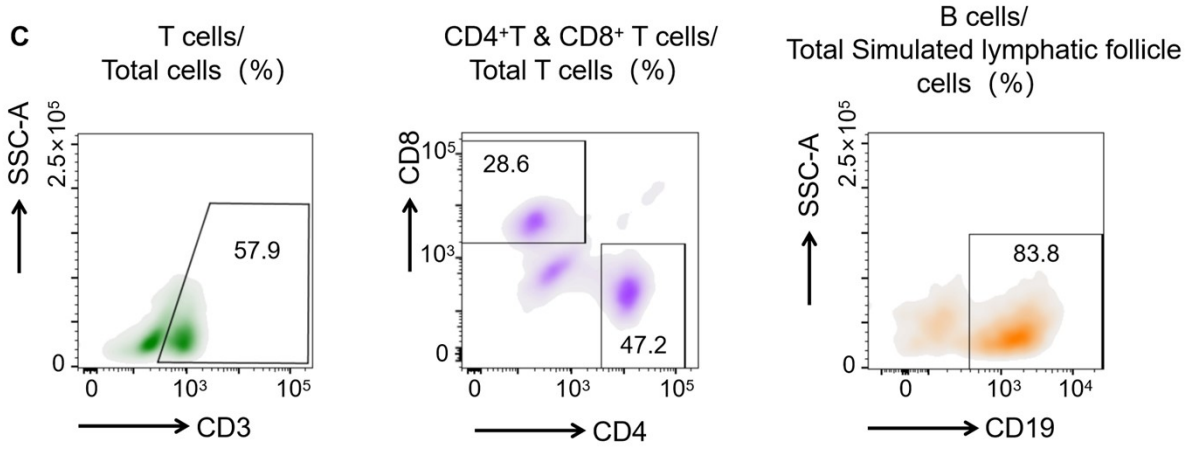


Figure S4. Introduction of the *in vitro* lymph node model in this study. (A) Schematic illustration of the main structure and cell composition of the *in vitro* lymph node model. (B) The percentage of various types of cells in the *in vitro* lymph node model and (C) representative diagrams of flow cytometry.

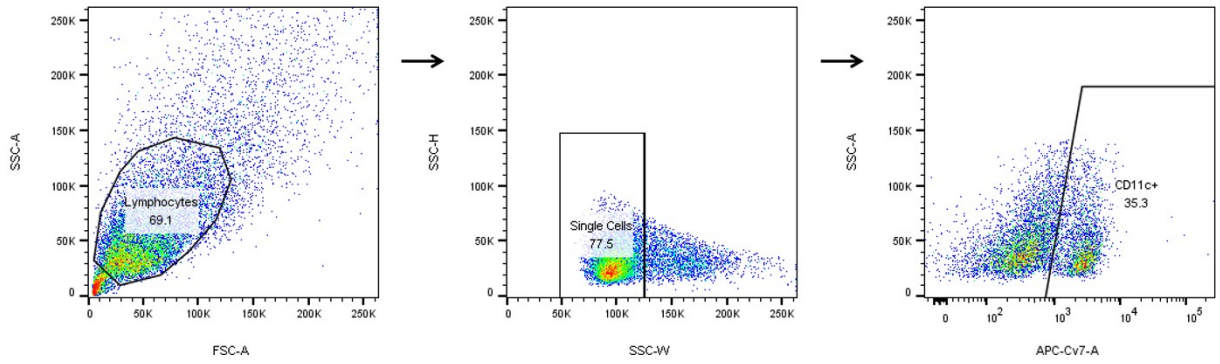


Figure S5. The gating strategy for Figure 5B-G.

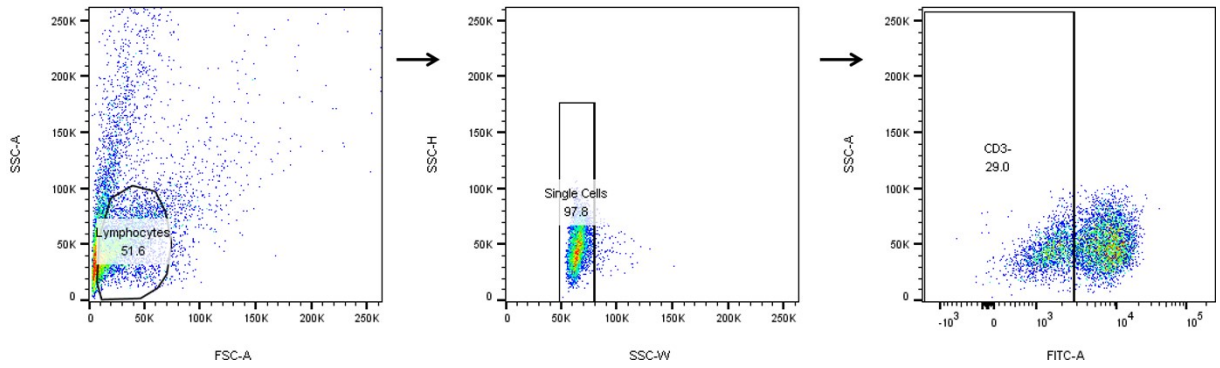


Figure S6. The gating strategy for Figure 5H-K.