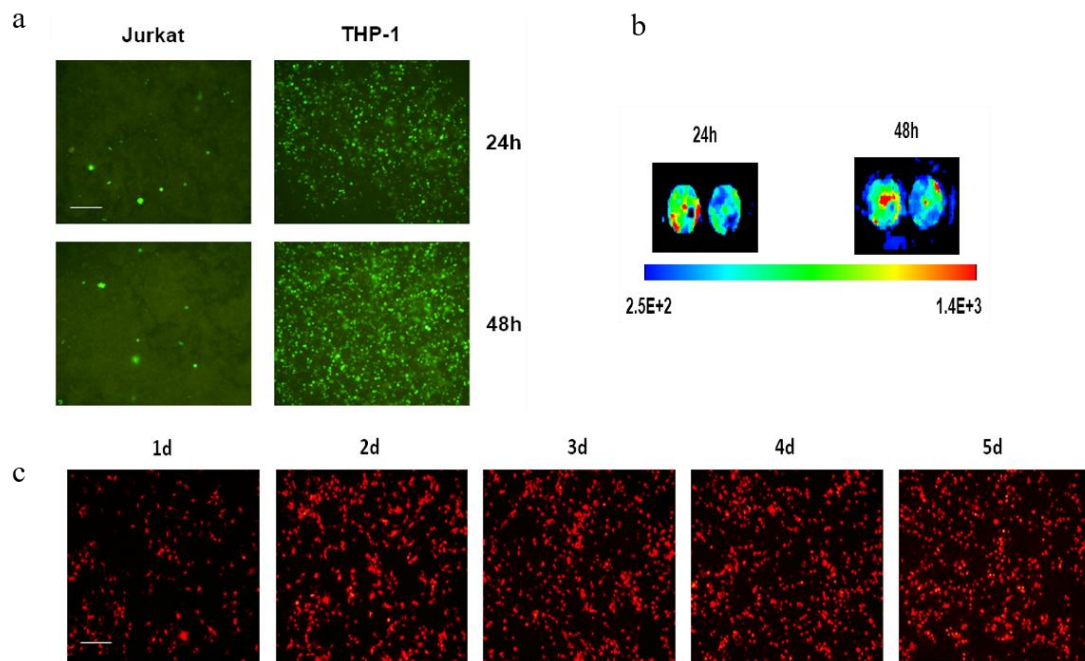
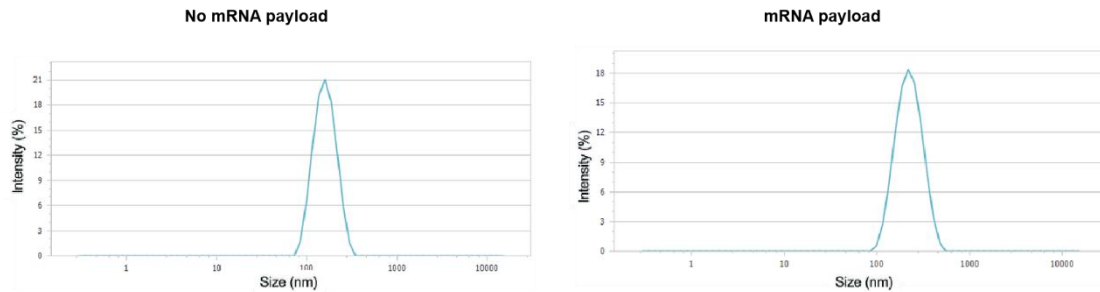


Supplementary Figure 1



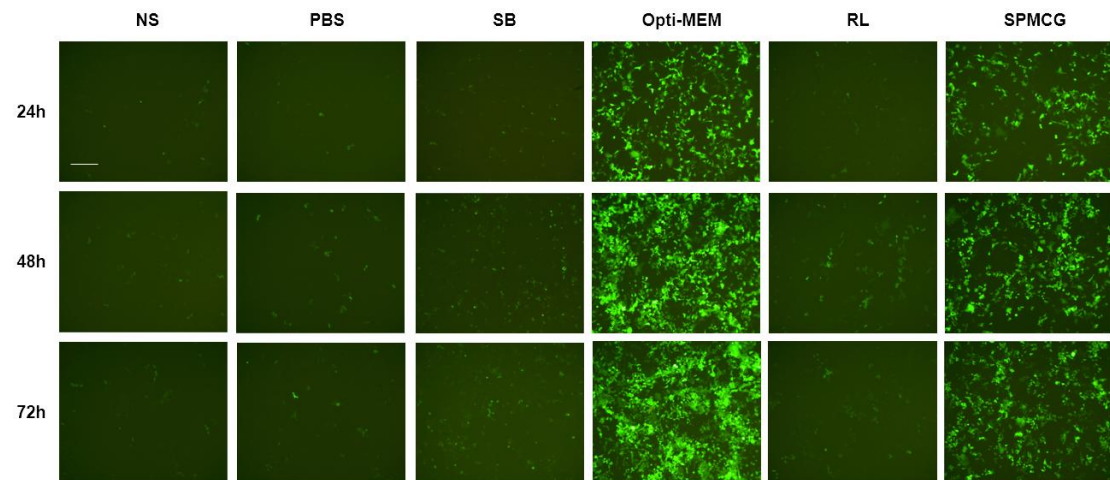
**Supplementary Figure 1** The transfection characteristics of lipoplex LNP3 investigated. a, LNP3-mediated EGFP mRNA transfection to suspension cells, Jurkat and THP-1, and the results were collected from the time points of 24 and 48h after transfection. b, firefly luciferase mRNA delivered to HEK293T cells by LNP3, and bioluminescence imaging were collected 24 and 48 hours later. c, self-amplifying RNA expressing mKate was transfected to HEK293T cells using LNP3, and the fluorescent images were collected for five days. Scale bar, 100 $\mu$ m.

## Supplementary Figure 2



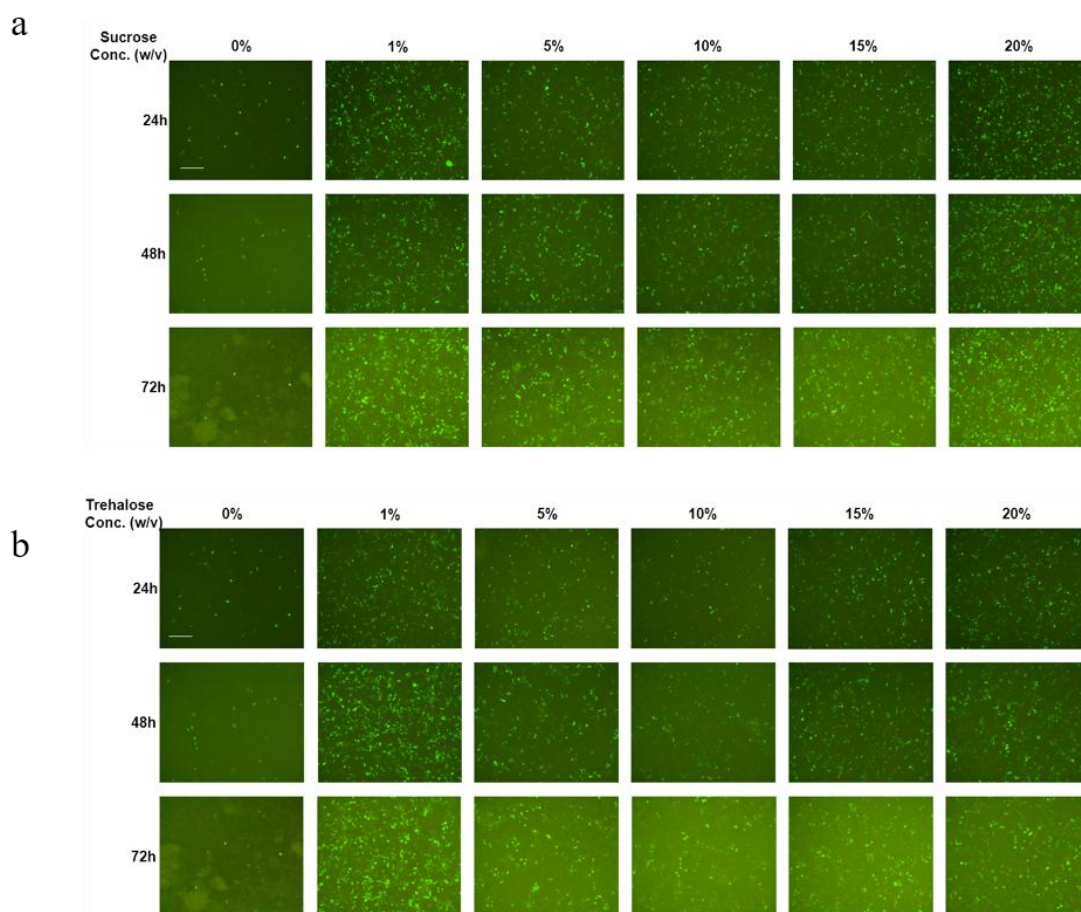
**Supplementary Figure 2** When LNP3 and mRNA complexed as N:P was 1.7:2, the average of the particle size was 163.70nm and the zeta potential average value was 23mV in the absence of mRNA payload, while the average of the particle size was 231.26nm and the zeta potential average value is -27mV after mRNA payload.

Supplementary Figure 3



**Supplementary Figure 3** Investigation of buffer-formulated mRNA-LNP4 complex transfection effect. Comparison of different solutions as formulated buffers for mediating mRNA-LNP4 transfection to HEK293T cells. NS, normal saline, SB, sodium bicarbonate solution, RL, ringer lactate solution, PBS, phosphate buffer solution, SPMCG, sodium potassium magnesium calcium and glucose solution. The fluorescent images were collected from three time points after transfection, 24, 48 and 72 h. The scale bar was 100  $\mu\text{m}$ .

Supplementary Figure 4



**Supplementary Figure 4** Transfection activity investigation of mRNA-LNP3 after lyophilization and rehydration using SPMCG as formulated buffer. a, effect of sucrose concentration on EGFP mRNA delivery and expression to HEK293T cells mediated by LNP3 during lyophilization and rehydration. b, effect of trehalose concentration on EGFP mRNA delivery and expression to HEK293T cells mediated by LNP3 after lyophilization and rehydration. w/v represents mass to volume ratio. The fluorescent images were collected from three time points after transfection, 24, 48 and 72 h. The scale bar was 100  $\mu\text{m}$ .