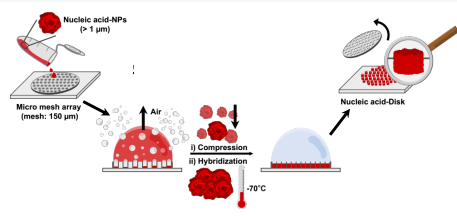


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Introduction



Abstract Nucleic acid, essential to all known forms of life, has excellent biocompatibility and biodegradability but there are many limitations of it. In this regard, a variety of nucleic acid-based nanostructures has been developed and nucleic acid nanoparticles (NAPs) are one of them. NAPs fabricated by rolling circle replication (RCR) process had a massive amounts of nucleic acids with tandem repeats of the same sequences. In this project, we developed nucleic acid-based micropatterning, compressing NAPs by air pressure. Micro-disk structure produced by this process had high stability compared to nanoparticle units, and good controllability as a carrier in drug delivery system. Further, we used CpG incorporated nanoparticles which has been spotlighted in the therapeutics area and applied various applications to demonstrate the potential of our platform.

Result

Fabrication & Characterization

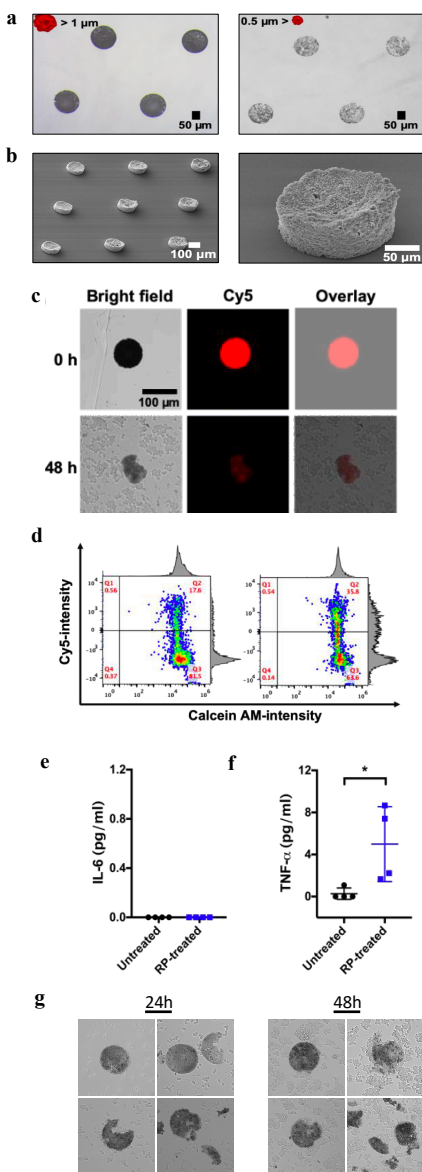


Figure 1. Fabrication and characterization of micro-pattern disk made with RNA scramble microparticles **a** microscopic images of size-dependent micro-pattern disk **b** Scanning Electron Microscopic (SEM) images of (a) **c** fluorescence images of Cy5-labeled disk structure with macrophage (upper: 0 h, bottom: 48 h) **d** cytometry analysis for macrophages treated with disk for 48 h (left: un-labeled, right: Cy5-labeled) **e, f** quantitative analysis of IL 6, TNF- α expressed from RAW264.7 cells treated with disk **g** microscopic images of disk structure treated with serum for 24 h(left), 28 h(right)

CpG DNA Microparticles

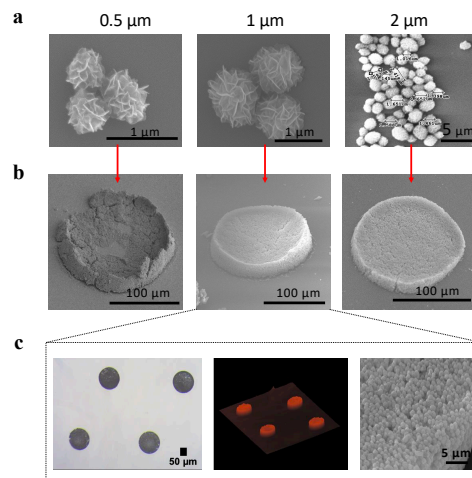


Figure 2. CpG incorporated DNA microparticles (CpG MPs) **a** SEM images of CpG MPs with various sizes **b** SEM images of micro-pattern disk made with each size of CpG MPs of **a** **c** microscopic images of micro-pattern disk made with 1 μ m size of CpG MPs (left), 3D image of micro-pattern disk structure manipulated with contrast of left (middle), microscopic image of disk structure made with 1 μ m size of CpG MPs (right)

Optimization

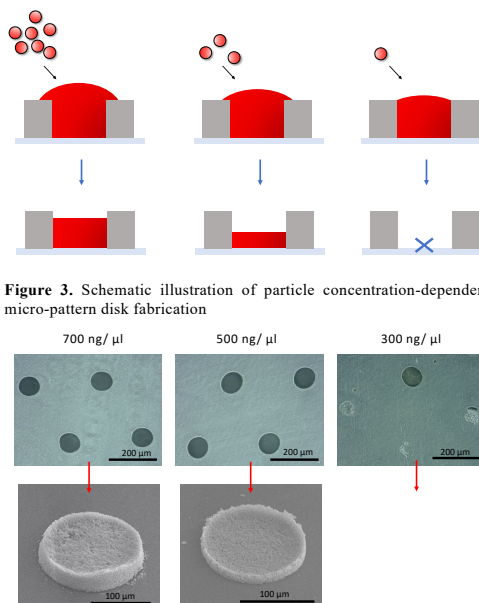


Figure 3. Schematic illustration of particle concentration-dependent micro-pattern disk fabrication

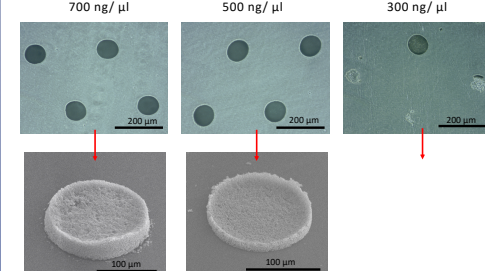


Figure 4. Microscopic images of particle concentration-dependent micro-pattern disk made with CpG MPs (upper), SEM images of particle concentration-dependent micro-pattern disk made with CpG MPs (below)

Future Application

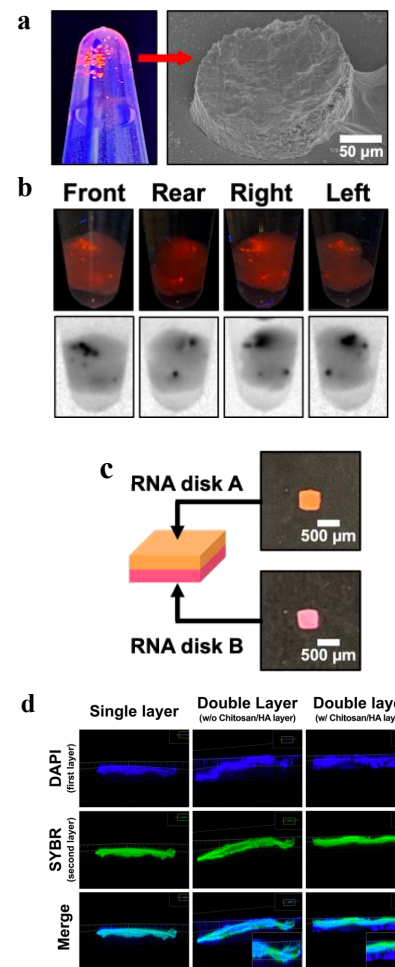


Figure 5. Future application of micro-pattern disk platform **a** fluorescence images of collected disk structure stained with Gelred in the media **b** fluorescence images of disk encapsulated by DNA hydrogel **c** digital images of janus disk (upper: RNA A MPs, below: RNA B MPs) **d** confocal microscopic images of janus disk (left: single layer with mixed RNA A MPs + RNA B MPs, middle: double layer without chitosan/HA layer, right: double layer with chitosan/HA layer, RNA A was stained with DAPI, RNA B was stained with SYBR II.

Conclusion

- **Nucleic acid-based micro-pattern disk structure** could be fabricated nucleobase sequence independently.
- ✓ This platform has demonstrated outstanding stability and biocompatibility compared to existing other nucleic acid-based nanostructures.
- ✓ It showed highly applicable potential.