Particle-Array Guided Photoalignment and Patterning of DNA Hydrogels via UV Scanning

Juri Kim[1] *and Dong Ki Yoon*[1]*

[1]*Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Daejeon 34141, Republic of Korea*

**Email of communicating author: nandk@kaist.ac.kr*

Pattern formation in soft hydrogels remains challenging because of their low mechanical stability and the difficulty of simultaneously controlling molecular orientation. Conventional strategies for anisotropic patterning often rely on complex techniques, including surface alignment layers, multi-step lithographic templating, or liquid crystal systems incorporating specially designed photoreactive mesogens [1].

Here, we show that DNA can serve as an intrinsic photoalignable material without sequence engineering or functional group modification. Strong electrostatic coupling between negatively charged DNA and cationic photopolymerizable monomers allows scanning UV irradiation to generate directional mass transport, aligning DNA chains along the scanning direction and forming uniaxially ordered hydrogels with anisotropic properties. Furthermore, introducing particle-array substrates locally perturbs diffusion-induced mass flow, simultaneously producing guided molecular alignment and periodic hydrogel patterning without predesigned photomasks or surface-modified alignment layers. Our results establish DNA as a scalable, sequence-independent, and biocompatible platform for anisotropic photopatterning, providing new opportunities for structured biopolymer-based soft materials.

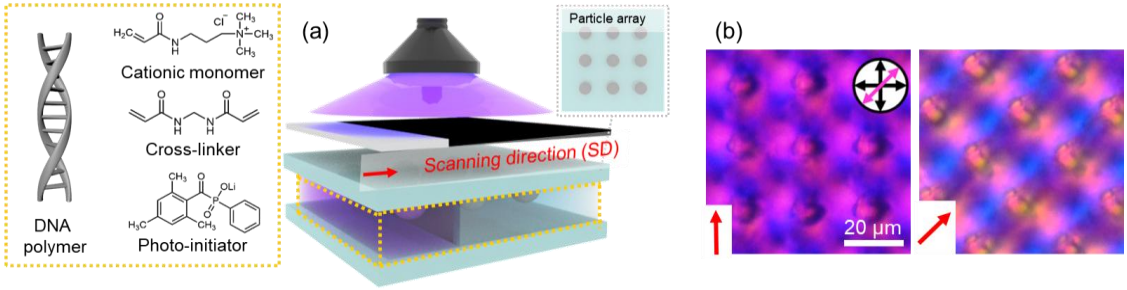

Figure 1. Substrate-guided pattern formation in photoaligned DNA hydrogels. (a) Schematic illustration of the scanning UV irradiation setup on a particle-array substrate. (b) Corresponding POM images of DNA hydrogels after line-shaped UV scanning. The red arrows indicate the scanning direction (SD).

References

[1] Cole A. DeForest et al, “Surface Patterning of Hydrogel Biomaterials to Probe and Direct Cell–Matrix Interactions”, *Adv. Mater. Interfaces* **7**, 2001198, 2020.