NANO HIGHLIGHT

Polymer Nanoengineering: Advances for Drug and Gene Delivery

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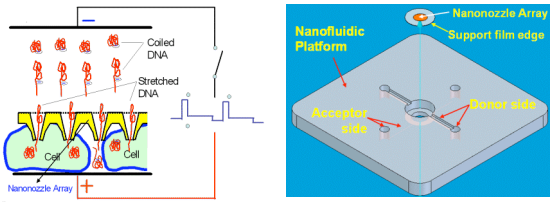
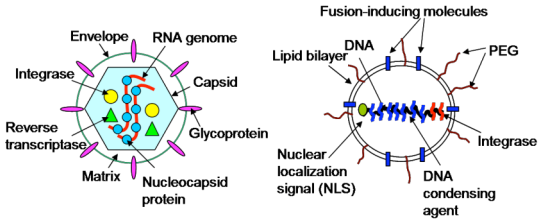


(a) (b)

Figure 1. (a) Schematic of cell patch for delivery of large genes; (b) Experimental setup of the microfluidic platform



(a) (b)

Figure 2. Diagrams of a retrovirus and a multifunctional nanoparticle for gene delivery.

Current drug and gene delivery methods have limitations, such as safety issues and low efficiency *in vivo*. A nanofluidic "cell patch" device, which integrates layers of polymeric nanochannels into a single microfluidic device, has been developed in our laboratory. When an electric field is applied, the nanochannels provide a focused electric field that can accelerate the transport of species (such as DNA) or drugs into the cells close to the outlet of the Nanochannels (see Fig. 1a). It has great potential to deliver genes or drugs efficiently and safely at the cell or tissue level. The miniaturized microfluidic platform for the cell patch is depicted in Figure 1b.

One of our long-term goals is to design a nanofactory capable of synthesizing virus-like polymer-DNA conjugates. For gene therapy, it would be very valuable to create an artificial virus that possesses the high transfection efficiency of a biological retrovirus (Figure 2a) without its associated toxicity and immunogenicity. Figure 2b shows a proposed design.

We are developing a strategy based on patterning that stretches DNA into a highly ordered array to create nanoparticles containing multiple components with well-defined structures. By combining molecular combing and microcontact printing, we have developed a simple and robust technique (Figure 3) capable of generating highly ordered arrays of DNA nanostrands (Figure 4).[1]

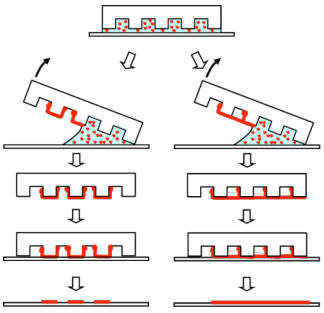


Figure 3. Schematic of generating and transferring DNA nanostrand array

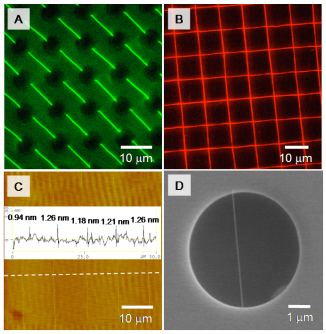


Figure 4. Fluorescence (false colors, A and B), (C) AFM, and (D) SEM images of DNA

References

[1] J. Guan, L.J. Lee, "Generating Highly Ordered DNA Nanostrand Arrays," Proceedings of National Academy of Science, USA, 102(51), 18321 (2005).

[2] For further information about this project visit www.nsec.ohio-state.edu.