Microrheology in DNA hydrogels

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DNA provides great promise as a structural building block in biological science and nanotechnology, owing to its highly specific binding properties allowing for precise control over molecular structures[1]. In recent years, hydrogels purely made of DNA or DNA-tethered polymers have brought wide interest[2][3]. However, the current research mainly focuses on bulk-scaled fabrication and characterization. It remains a challenge to understand the fundamentals of molecular-scale picture of DNA hydrogels.

We developed microrheology to do in-house real-time measurements of DNA hydrogels[4]. A three-branched DNA strcuture plays as the building block in our system. The hydrogel is cross-linked by DNA hybridization between complementary single-stranded DNA sequences on different three-branches units. We probed the viscoelastic properties of the sample material around the melting temperature of DNA sticky overhangs. Our results indicate the gelling process occurs in a narrow region around melting temperature. Furthermore, we systematically investigated the mechaniscs properties of the gel at given temperatures below the melting point. The results provide crtical undertanding on the fundamental aspects of DNA-hydrogels in micro-scale, allowing for an more accurate design and precise tuning the gelation process of the studied material. This in the long term has the prospective in achieving efficient and inexpensive selective material for DNA sequencing.

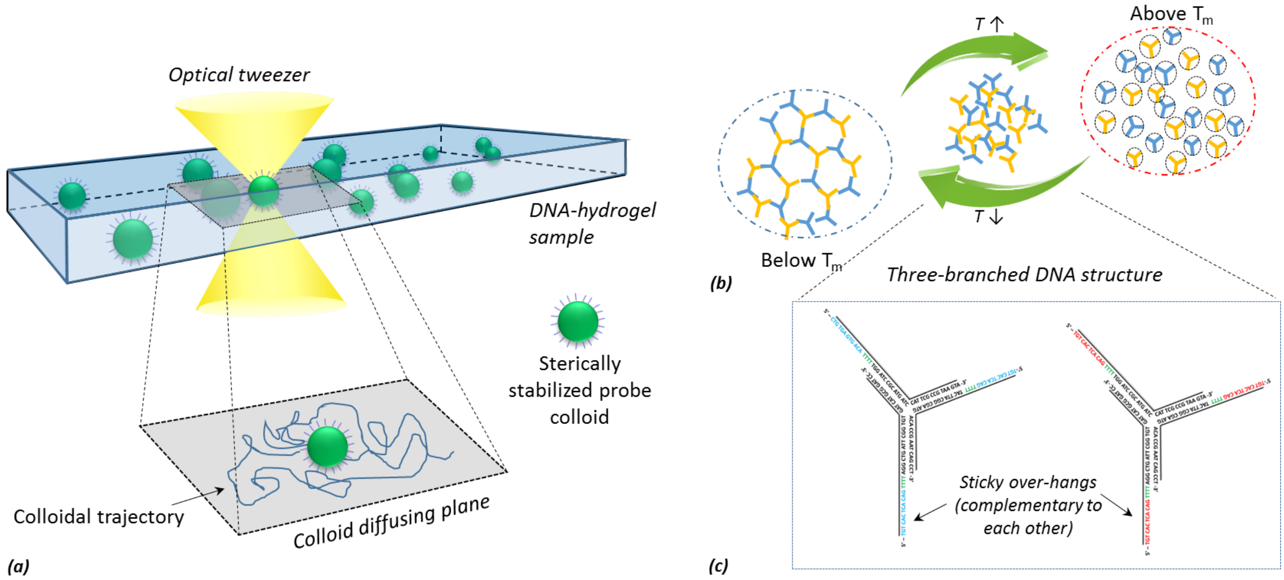

Figure 1 (a) Micro-rheology setup to extract complex moduli of DNA-hydrogels from the trajectory of embedded probe colloids. (b) Micro-structure of DNA-hydrogels played with temperature. (c) Cartoon of three-branched DNA building block.

Acknowledgements The financial supports come from the Winton Pump Grants.

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