Supplementary Information

Branch-convergence structure based on double-layer chip: a universal method for enhancing microfluidic mixing

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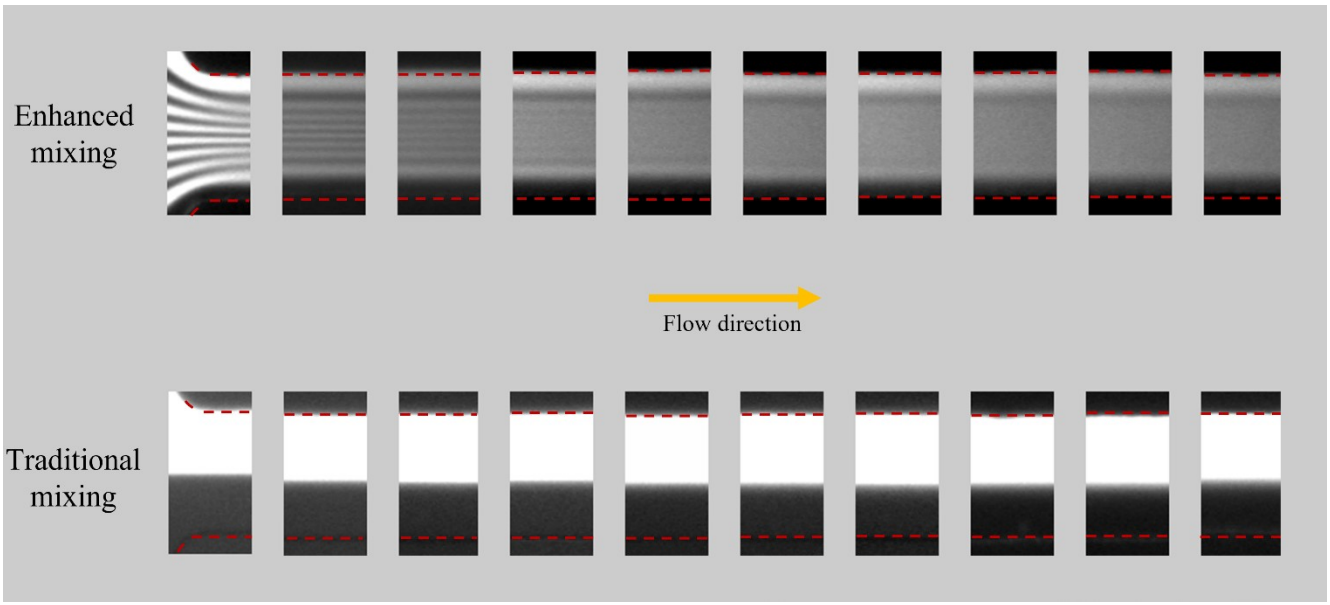

Figure S1. Comparison of mixing performance at different positions in the straight channel. Images were taken every 1 mm along the flow direction from the beginning of the straight channel. Enhanced mixing can significantly shorten the diffusion length compared to traditional mixing.

Considering the maturity of the field of microfluidic mixing, a case study of its application in DNA storage is given here. In order to meet the requirements of long-term storage of DNA data, we need to encapsulate DNA in calcium carbonate nanoparticles to reduce the degradation rate of DNA. First, the DNA sample is mixed evenly with calcium chloride solution at a ratio of 1:50, and then the mixed solution and sodium carbonate solution are introduced into the hybrid chip at a ratio of 1:1 for DNA mineralization. After 5 minutes, the mineralized product is collected, centrifuged and the precipitate is resuspended to obtain the mineralized sample of DNA. The demineralization of DNA is to mix the mineralized DNA sample with EDTA solution at a ratio of 1:1, continue the reaction for 5 minutes, and release the encapsulated DNA molecules. We performed PCR amplification and sequencing verification on the demineralized DNA sample. The results showed that the sequence of the demineralized DNA sample was consistent with the original DNA sequence, indicating that the hybrid chip can be used as a useful tool in the field of DNA data storage.

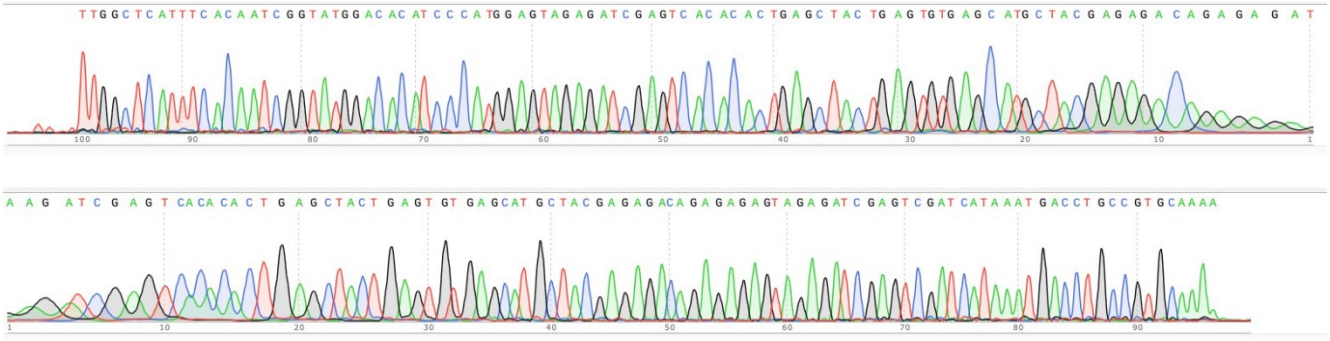

Figure S2: The results of DNA sequencing. The original sequence is TGGCTCATTTCACAATCGGTATGGACACATCCCATGGAGTAGAGATCGAGTCACACACTGAGCTACTGAGTGTGAGCATGCTACGAGAGACAGAGAGAGTAGAGATCGAGTCGATCATAAATGACCTGCCGTGCAA. The sequencing results were consistent with the original sequence.