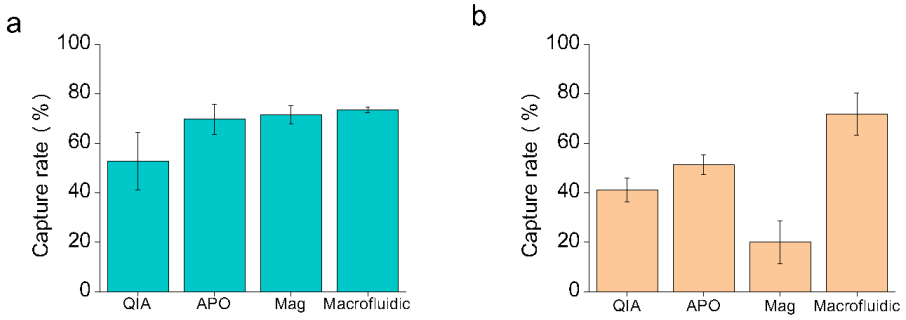
Project Title: Highly efficient isolation of short-length cell free DNA with nanowires
納米線高效分離短片段血漿游離 DNA

PI: Prof Michael YANG

Cell-free DNA (cfDNA) contains valuable information about the human body and can be used for diagnosing diseases and evaluating therapy efficacy in cancer, pregnancy, and organ transplantation. In liquid biopsy, capturing high amounts of cfDNA from biological samples is essential before detecting cfDNA. However, currently available commercial kits for capturing short cfDNA are unsatisfactory, leading to a loss of short cfDNA.

Here, a novel microfluidic device integrated with nanowires is presented, which can improve cfDNA capturing. PMMA nanowires are fabricated using anodic aluminum oxide (AAO) templates and are modified with mercaptosuccinic acid (MSA), as confirmed by energy dispersive X-ray spectroscopy (EDX) and contact angle measurement. The successful MSA modification was indicated by the presence of Au and S elements, and a decrease in the contact angle value from 120° to 13°. A PDMS layer is designed and fabricated with channel patterns and is integrated with nanowires to create a microfluidic device. The device's ability is then tested to capture 87bp DNA spiked into plasma to mimic short cfDNA in biological samples. The capturing ability is evaluated by using QPCR with different nanowire parameters and the binding buffer is optimised. The optimal ratio of alcohol to PEG in the binding buffer was 0.75:1, and the ideal nanowire height was 50µm, while the nanowire diameter ranging from 40nm to 90nm had no effect on the capture rate of 87bp DNA.

The microfluidic device showed a significantly higher capturing rate than commercial kits for capturing 87bp DNA from plasma. In summary, a novel microfluidic device with higher short cfDNA capture ability than commercial kits is demonstrated, which are useful for developing cfDNA biosensors and clinical cfDNA detection.



Compare 87bp DNA capture rate between commercial kits and microfluidic device
(a): Comparison in 87bp DNA spiked-in PBS (b): Comparison with 87bp DNA spiked-in plasma