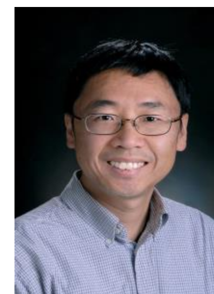
# Queensland Micro- and Nanotechnology Centre

Griffith UNIVERSITY

# SEMINAR



**Speaker:** Professor Paul C.H. Li
Department of Chemistry
Simon Fraser University
Canada

**Date:** Thursday 1 March 2018

**Time:** 11.00 am

**Venue:** Room 1.08 QMF building (N74), Griffith University, Nathan Campus

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**Title:** **Microfluidic Nanotechnology: Innovations and Applications**

**Abstract:**
We employ a NanoBioArray chip together with gold nanoparticles to help discriminate between single base-pair mismatched DNA molecules in nucleic acid assays. Here, gold nanoparticles (AuNPs) have been used for detection. However, there is a poor fundamental understanding of how gold nanoparticle surfaces influence the DNA hybridization process. Here, we measured the rate constants of the hybridization and dehybridization of DNA on gold nanoparticle surfaces to enable the determination of activation parameters using transition state theory. We show that the target bases need to be detached from the gold nanoparticle surfaces before zipping. This causes a shift of the rate-limiting step of hybridization to the mismatch-sensitive zipping step. Furthermore, our results propose that the binding of gold nanoparticles to the single-stranded DNA segments (commonly known as bubbles) in the duplex DNA stabilizes the bubbles and accelerates the dehybridization process. We employ the proposed mechanism of DNA hybridization/dehybridization to explain how 5 nm diameter gold nanoparticles help discriminate between single base-pair mismatched DNA molecules, related to the cancer gene KRAS, when performed in a NanoBioArray chip.

We employed the microfluidic biochip to conduct the same-single-cell analysis (*SASCA*). This analysis allowed us to obtain drug accumulation information in assays of multidrug resistant (MDR) cancer cells. MDR is one of the major obstacles in cancer drug delivery. MDR may be overcome by using MDR inhibitors. Among different classes of these inhibitors, less toxic amphiphilic diblock copolymers composed of methoxypolyethyleneglycol-block-polycaprolactone (MePEG-b-PCL) have been studied extensively. Using conventional assays, it was found that the low-molecular-weight diblock copolymer, $MePEG_{17}$-b-$PCL_5$ (PCL5), enhanced drug accumulation in MDCKII-MDR1 cells. However, when the high-molecular-weight nanoparticles, $MePEG_{114}$-b-$PCL_{200}$ (PCL200), were mixed with PCL5 (and the cancer drug) in order to encapsulate them to facilitate drug delivery, there was no drug enhancement effect attributable to PCL5. The reason for this negative result was unclear. Since drug accumulation measured on different cell batches originated from single cells, we employed the microfluidic biochip to conduct the same-single-cell analysis (*SASCA*) to find out the reason. This analysis allowed us to obtain drug accumulation information faster in comparison to conventional assays. The *SASCA* results have confirmed that when PCL5 was encapsulated in PCL200 nanoparticles as soon as they were synthesized, the ability of PCL5 to enhance cancer drug accumulation was retained, thus suggesting the PCL200 nanoparticle as a promising delivery system for encapsulating MDR inhibitors, such as PCL5.

***ALL WELCOME***

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