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## Development toward a multi-marker and label-free platform sensor technology using electrochemical impedance spectroscopy and nanomaterials

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In complex diseases such as cancer and Cardiovascular Diseases (CVD), there has been an increasing need to measure multiple markers simultaneously for disease management and detection as a single biomarker cannot sufficiently represent the series of intricate physiological phenomenon. Comparing to traditional multi-marker testing methods that often utilize sensor arrays, Electrochemical Impedance Spectroscopy (EIS) offers a rapid, label-free, and ultrasensitive means to measure multiple markers simultaneously on just a single sensor. A novel analytical algorithm using the imaginary impedance is introduced as a proof of concept for multi-marker detection. By using this algorithm, an optimal frequency at which the resulting impedance best correlate to target's concentrations can be identified, offering an orthogonal detection approach in addition to the specific binding between a target and its Molecular Recognition Element (MRE). The algorithm is applied to show feasibility in detecting HDL and LDL, two strong predictors of CVD risk levels, simultaneously on a gold disc electrode sensor at 3.09Hz and 175.8Hz, respectively. To solve potential signal aliasing in future development of a multi-marker sensing platform, the algorithm is used to evaluate the tuning effect of nanoparticle conjugations onto the IL-12 antibody. Comparing to the control, it is observed that 5 nm, 10 nm, and 20 nm gold nanoparticles can shift the optimal frequency by 64.2Hz, 4.05Hz, and -14.09Hz, respectively, and alter the full width half maxima by 295Hz, 79.9Hz, and 10.73Hz, respectively.

### Biography

Chi Lin is currently pursuing his PhD from Arizona State University through the School of Biological and Health Systems Engineering under the mentorship of Dr. Jeffrey T LaBelle. He is the leader of four projects under the LaBelle's Lab: Dry eye sensor for advance tear diagnostics, LLC, Saliva glucose sensor, TOUCH tears glucose sensor and Tunable EIS multimarker detection team. He is specialized in "The design and development of electrochemical sensors for various applications".

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