High Throughput RF Bio Sensors

CNF Project Number: 1606-07
Principal Investigator(s): Pingshan Wang
User(s): Md Saiful Islam

Affiliation(s): Electrical & Computer Engineering, Clemson University

Primary Source(s) of Research Funding: Army

Contact: pwang@clemson.edu, mdsaifi@clemson.edu

Primary CNF Tools Used: ABM Contact Aligner, SÜSS MA6-BA6 Contact Aligner, CHA Mark 50 E-beam Evaporator, Heidelberg Mask Writer - DWL2000, Glen 1000 Resist Strip

Abstract:

The aim of this research is to build a microstrip based sensor that has integrated microfluidics to transport biological cells. The sensor will be able propagate low power microwave (100MHz to 15GHz) microwave signals. Biological Cells transported to the sensor will generate electrical signal which will correspond to the dielectric material change. This sensor will be a non-invasive method to analyze biological cells. The sensors are designed to analyze Chinese Hamster Ovarian Cells (CHO) for a comprehensive study of the cell life cycle, different drug effects, conditions effecting the production of protein by the CHO cells, identifying sub-populations that has higher protein yield. Apart from that another set of sensors were built to do similar analysis on candida yeast cells. These investigations will also include SF9 line of cells for cell apoptosis and different virus infection state identification.

Summary of Research:

The work we did in June 2023 at CNF was to build new devices based on the results obtained earlier this year. In Figure 1, we achieved to demonstrate scattering parameter signals differentiate two different variants of Chinese Hamster Ovarian (CHO) cells. Namely VRC01 and PF variants. In that experiment about 50 individual CHO cells of each type were measured by the sensor (one at a time). Their corresponding scattering parameter scatter plot showed a noticeable difference. However, the sensor had inherent design flaws as in the metal used for the microwave circuit used copper, which would corrode over time and render the sensor unusable. Apart from that the idea of having multiple channel passes with the microfluidic system did not offer any benefits. To remedy this, we came up with some modifications in the microfluidics and planned on changing the metal deposition to Ti-Au-Ti. Some delay line fluidic channel and cell trapping mechanisms were introduced in the microfluidics. The new design has been fabricated over June. We are preparing to run experiments with it on biological cells like CHO, SF9, and candida yeast cells.

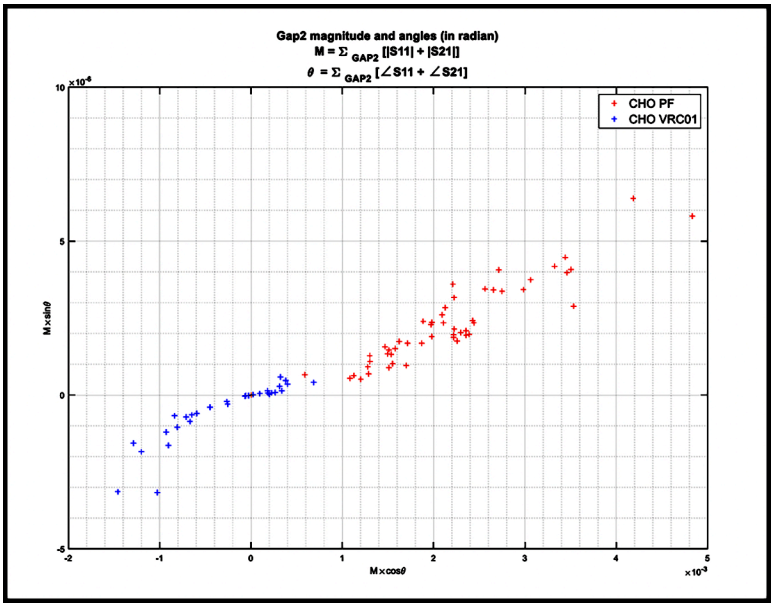

Figure 1: Scattering parameter scatter plot of CHO VRC01 and CHO PF cells.

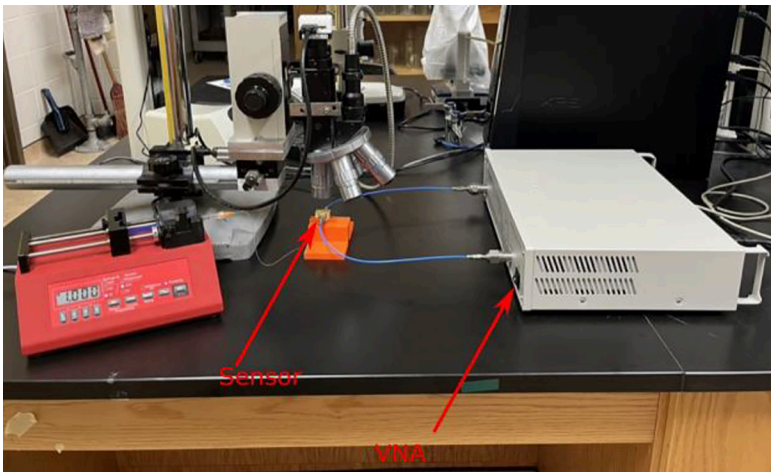

Figure 2: Experimental setup for the results obtained in Figure 1.

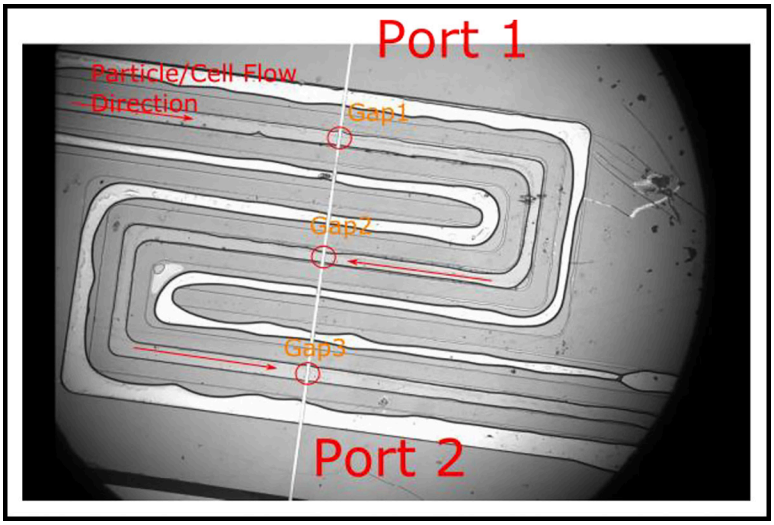

Figure 3: Microscopic view of microfluidics of the sensor used in Figs 1 and 2.