

# Internship Report

## I. Technical Part

### a. Literature review and critical thinking

The company that I worked for my summer internship, PointFit Technology Ltd., is a biotechnology company that has been making various contributions in the sports science and biomedical fields. They are mainly developing the wearable sweat biosensor that reads lactate concentration accurately, especially when you exercise. At some point of your sweating process, your body will start to provide energy anaerobically and that's when lactic acid is mostly generated in your blood and therefore in your sweat as well. Lactic acid, in other words lactate, is the chemical that we're trying to get reading of in order to determine everyone's lactate threshold. This term means your body muscles are working at their maximum level, and is very useful for training athletes to perform better day by day. Other focus we have is glucose (the data can also be collected simultaneously for different purposes such as determination of diabetic risks or level) or cortisol (using different method of sensor integration), but I was mainly assigned in the role revolving around lactate and glucose.

In the beginning, I was advised to read a number of research papers regarding their enzymatic sweat biosensor integration so that I can get familiar with what's going on, basic steps to prepare sample, and methods to perform experiments (to be further discussed in the following section b). As time passed by, it's time to finally test on other factors that affect the lactate reading such as pH, sodium, temperature, and sweat rate/humidity. These factors are proven useful for compensating the errors in lactate reading from the corresponding sensors. I obtained critical and analytical thinking skills at this stage and realized how important understanding the principles behind an innovation is in the research world. All preparations, set-ups, and benchmarks are based on existing studies and we make some changes from there; the starting line.

### b. Experiments

As for the sample preparation, I used the commercial Screen-Printed Electrodes (SPE using 3-electrodes-system comprising working, counter, and reference electrodes) and put Prussian Blue (PB) as the mediator for redox reactions to be sensed by the electrical system on top of the working electrode through spin-coating. Then, applying 1-3 IU Lactate Oxidase mixed with chitosan for enzyme immobilization with a particular ratio on top of PB, followed by storing it overnight in the fridge. The next day, this sensor is ready to be used for testing various chemicals or factors. For lactate, I had to drop many different concentrations of lactate from 3mM to 100mM on hydrogel placed on the working electrode of the prepared SPE, connect it to the commercial potentiostat, and run the CV (Current-Voltage) followed by the IT (Current-Time with applied voltage found on the peaks of CV previously: positive peak represents oxidation and negative peak represents reduction but we mostly used oxidation peak). Ideally, the results should show increasing trend of current in the IT graphs for increasing concentrations of lactate, provided that the CV oxidation peaks of those increasing concentrations also show rising behavior. As for

## Summer Internship

glucose, the sample preparation and experimental procedures are similar except it required glucose oxidase instead of lactate oxidase. In addition, we also did selectivity test with other substances occurring in sweat to confirm that it's sensitive particularly for lactate.

Besides, I helped out with making different solutions for experiments. These experiments I've described so far used commercial components in order to make calibration curves for being our standards. Of course, our company has our own SPE called PointFit Ace with similar function with the commercial SPE but with different materials. I've learnt how to screen-print the ACE manually and I believe the electrical team is trying to make our own potentiostat too. Next, I was working for testing many different factors affecting the lactate reading, such as pH, sodium, temperature, and humidity for shaping our data bank to be trained by machine learning models in order to make a formula for calculating more accurate lactate reading. pH and sodium sensors are developed with similar sensor integration and method but just some additions of new chemicals. Temperature factor can be tested by putting lactate on SPE with different temperature within human range. For humidity, we used MXene-PAAS on our membrane to be exposed to various saturated salt solution that can be regarded to absorb different amount of moisture, creating different % humidity (i.e., testing absorption and desorption ability of our sensor so that it is able to measure sweat rate). Real-time analysis with our membrane are also analyzed on one of our team members while exercising in the gym (one step closer to our goals as wearables).

### **II. Non-technical part**

Besides literature review and experiments, I had the responsibility to compile the data and think of the best way to make reader-friendly graphs, using Origin, Microsoft Excel, and Matlab. The working location I was assigned to were mostly one of the HKUST lab and our office room inside the startup zone. Honestly, the working environment was very positive in which everyone had their own specialty to contribute in our innovation. Additionally, I was fascinated with different kinds of chemical machines I was able to work with, such as UV machine, spin-coat machine, various chemicals, etc. Experiments are not always successful and failures are completely normal in the research world. Therefore, my courage are kept enthusiastic by the people in our company. Working together and helping each other out technically or mentally are always present in my workplace, which makes it possible for me to enjoy this experience. Discussions always occur when results and problems are found. My supervisors and seniors are welcome for questions and they're ready to listen to your opinions and/or teach you from the very basic. There are enormous things I haven't explained in details but these all are the things that can summarize my contributions along with things I've learnt and felt. This summer internship experience was truly a milestone in my study journey and career pathway.