

# ZP GLUCOSE SENSOR – COKE APPLICATION NOTE

**Martin Peacock**

## REVISION HISTORY

REVISION NUMBER	PAGE NUMBER	REVISION	DATE	NAME
1		Original document	Tuesday, July 10, 2018	Martin Peacock

## Contents

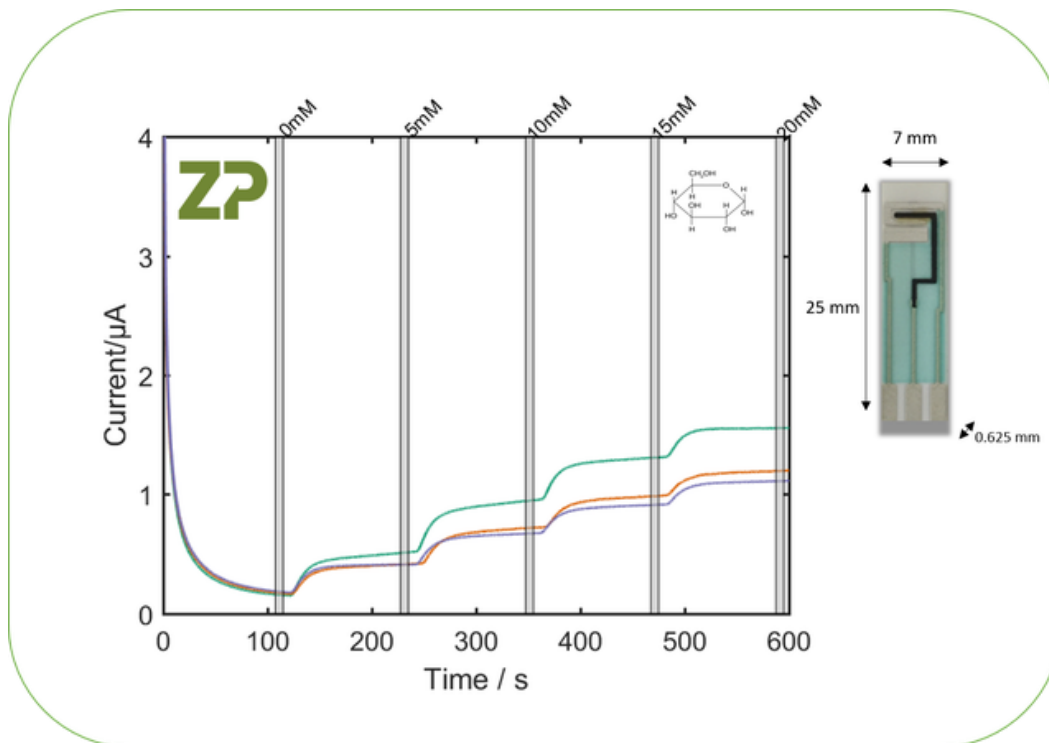
<b>REVISION HISTORY .....</b>	<b>1</b>
<b>INTRODUCTION –.....</b>	<b>2</b>
<b>THE THEORY .....</b>	<b>3</b>
<b>PRACTICAL.....</b>	<b>5</b>
<b>1.1 HARDWARE.....</b>	<b>5</b>
<b>1.2 EXPERIMENTAL STEPS .....</b>	<b>6</b>
<b>CLEANING AND STORING THE SENSOR .....</b>	<b>11</b>
<b>CONTACT ZIMMER AND PEACOCK.....</b>	<b>12</b>

## INTRODUCTION –

The detection of glucose is important in many industries and applications, from the monitoring of glucose for diabetics, to knowing the sugar in a soft drink, to measuring glucose in a bioreactor or cell culture.

In this application note we provide a simple experiment that can be performed outside of a laboratory with readily available drinks from the supermarket, and is intended to test and to gather the first data from a glucose sensor

With a glucose sensor one can perform quantitative and qualitative experiments. A quantitative experiment is where we measure and report the amount of glucose in a drop of blood for example, see Figure 1.0.0.



**Figure 1.0.0 – A ZP glucose sensors where increasing amounts of glucose are added to the sensor.**

The application experiment described within this document is a qualitative experiment, which requires no chemicals and can demonstrate a clear response by the sensor to regular coke relative

to coke zero which has no sugar. The output from the experiment is qualitative in that the output of the experiment is *'YES or NO, glucose is present'*.

## THE THEORY

In this application we take a Zimmer and Peacock glucose sensor and use it in conjunction with an AnaPot potentiostat, though the potentiostats from PalmSens also work in this application.

We will demonstrate the change in signal for ZP glucose sensor as we go from coke zero to normal coke.

A ZP glucose sensor is a Type One Glucose Sensor. A Type One Glucose Sensor typically utilizes glucose oxidase (GOx) as the sensing enzyme and oxygen naturally present in the solution as the mediator. The GOx enzyme catalyses the reaction between oxygen and glucose. with glucose initially converted to glucoactone, whilst the oxygen is converted to hydrogen peroxide. The hydrogen peroxide can diffuse to the working electrode where it is oxidized back to oxygen and two electrons are released to the electrode, these electronics are seen as a current by the potentiostat, see Figure 1.0.0.

The glucose oxidase in the ZP glucose sensors is immobilized, this means that the enzyme is held within a polymer and is not free to diffuse away from the sensor. This immobilized enzyme is a benefit as the sensors can be run in continuous monitoring operation where the sensors are within the sample and continuously measure the glucose signal. The ZP sensor shares some similarities to those of Dexcom and Medtronic which are also Type One Glucose Sensors with an immobilized enzyme formulation. The ZP glucose sensor can be contrasted with all/most self-monitoring-blood-glucose strips (SMBG), where the enzyme formulation is soluble and dissolves into the sample. These SMBG sensors are therefore a onetime use and not suitable for continuous monitoring.

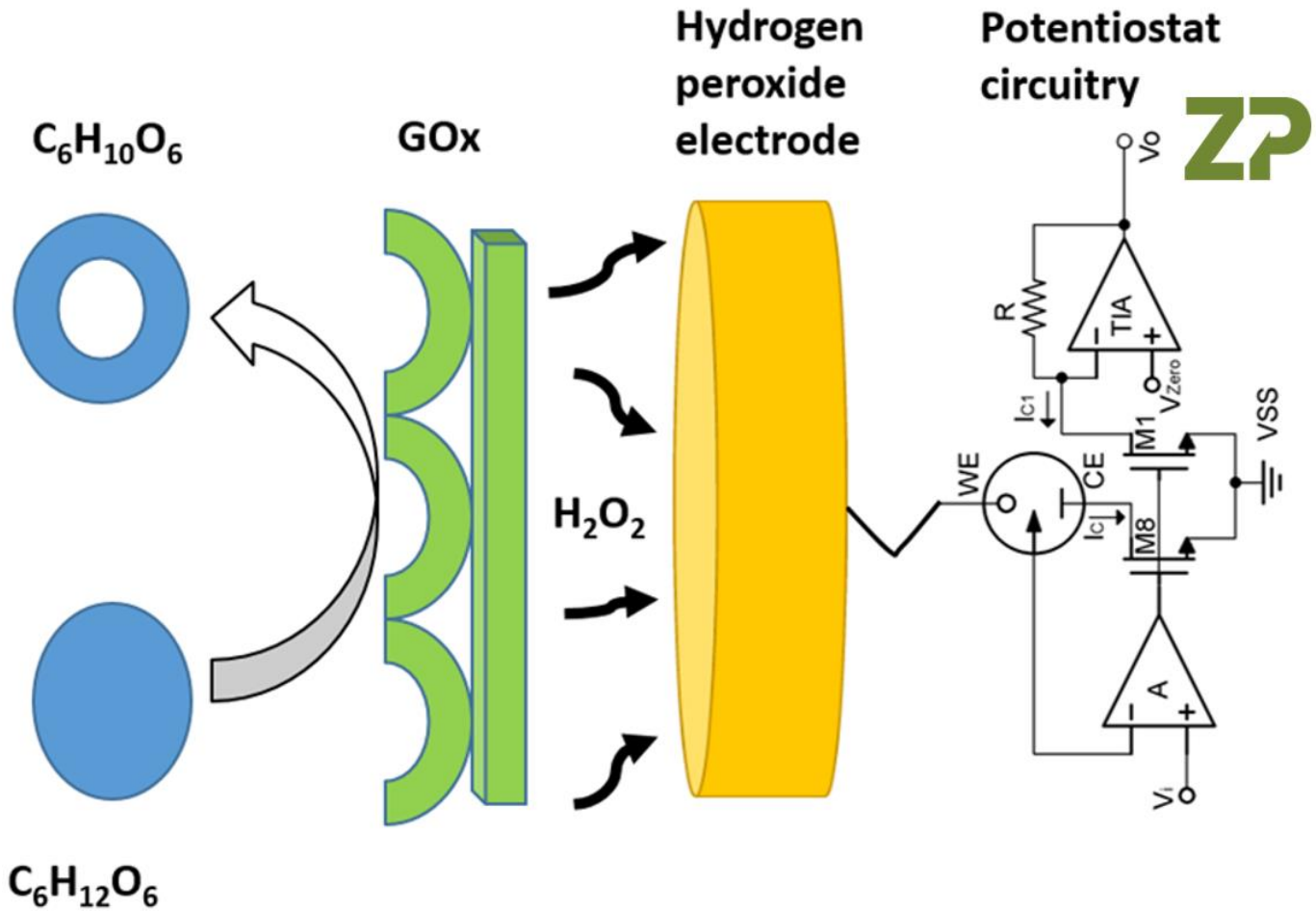


Figure 1.0.0 – Schematic of a Type 1 Glucose Sensor


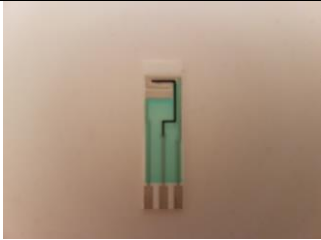
## PRACTICAL

To see a video demonstration of the application described within this document please see this video.

<https://www.zimmerpeacocktech.com/2018/05/25/measuring-sugar-in-coca-cola/>

### 1.1 Hardware

For the experiment described in this application note the following hardware and solutions are required, see Table 1.0.1.

Equipment	Image	Webpage	Comments
AnaPot		<a href="https://www.zimmerpeacocktech.com/products/ana-fleuve-buy-now/">https://www.zimmerpeacocktech.com/products/ana-fleuve-buy-now/</a>	The potentiostats from PalmSens can be used in place of the AnaPot
Glucose Sensor		<a href="https://www.zimmerpeacocktech.com/products/glucose-sensors/">https://www.zimmerpeacocktech.com/products/glucose-sensors/</a>	This is a Type 1 Glucose sensor. To re-use a sensor later please rinse the sensor with an excess of de-ionized water and pat the surface of the sensors dry with a tissue. What you are doing is removing the glucose and ensuring the sensor is dry. Then keep the sensors dry and cold/cool, for example in the fridge.
Test Solution	Coke Zero and Regular Coke		This is a qualitative experiment.

**Table 1.0.1 – Hardware for application note**

## 1.2 Experimental Steps

To perform this experiment please follow these STEPS.

- STEP ONE – Please place the ZP glucose sensor in the front of the AnaPot, or PalmSens, as shown in Figure 1.0.1.

**Figure 1.0.1 – Place the Glucose Sensor in the unit.**

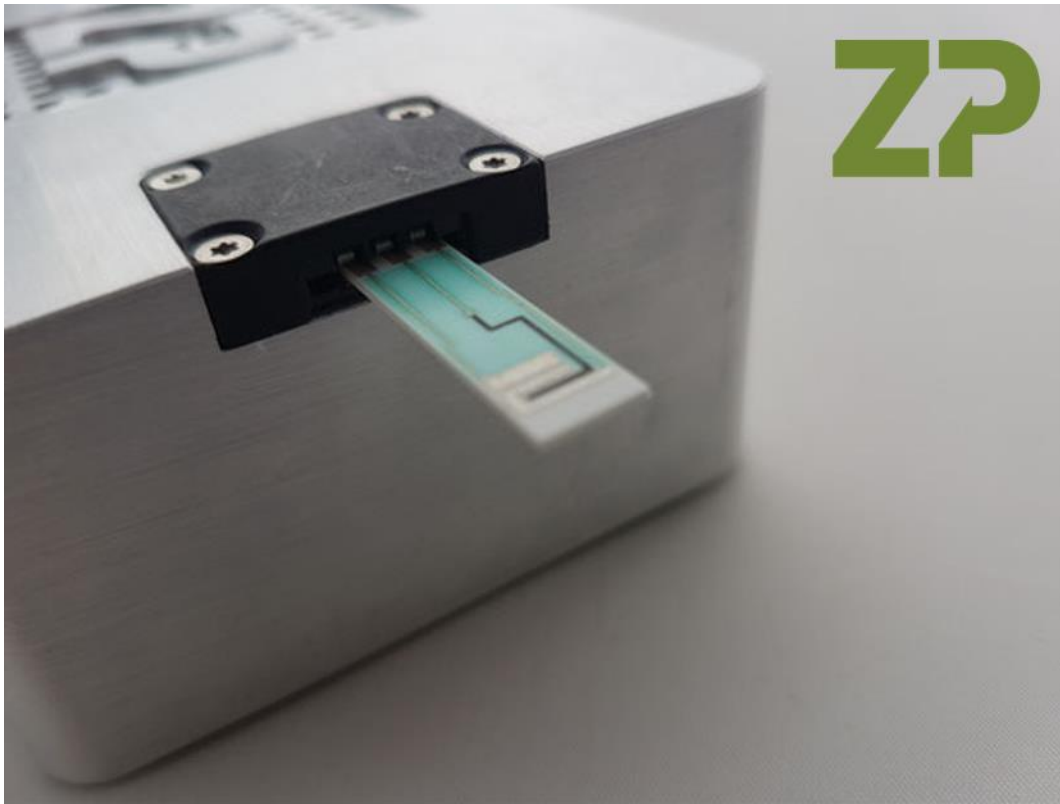


Figure 1.0.1

- STEP TWO  
The software is set up in accordance with Figure 1.0.2.

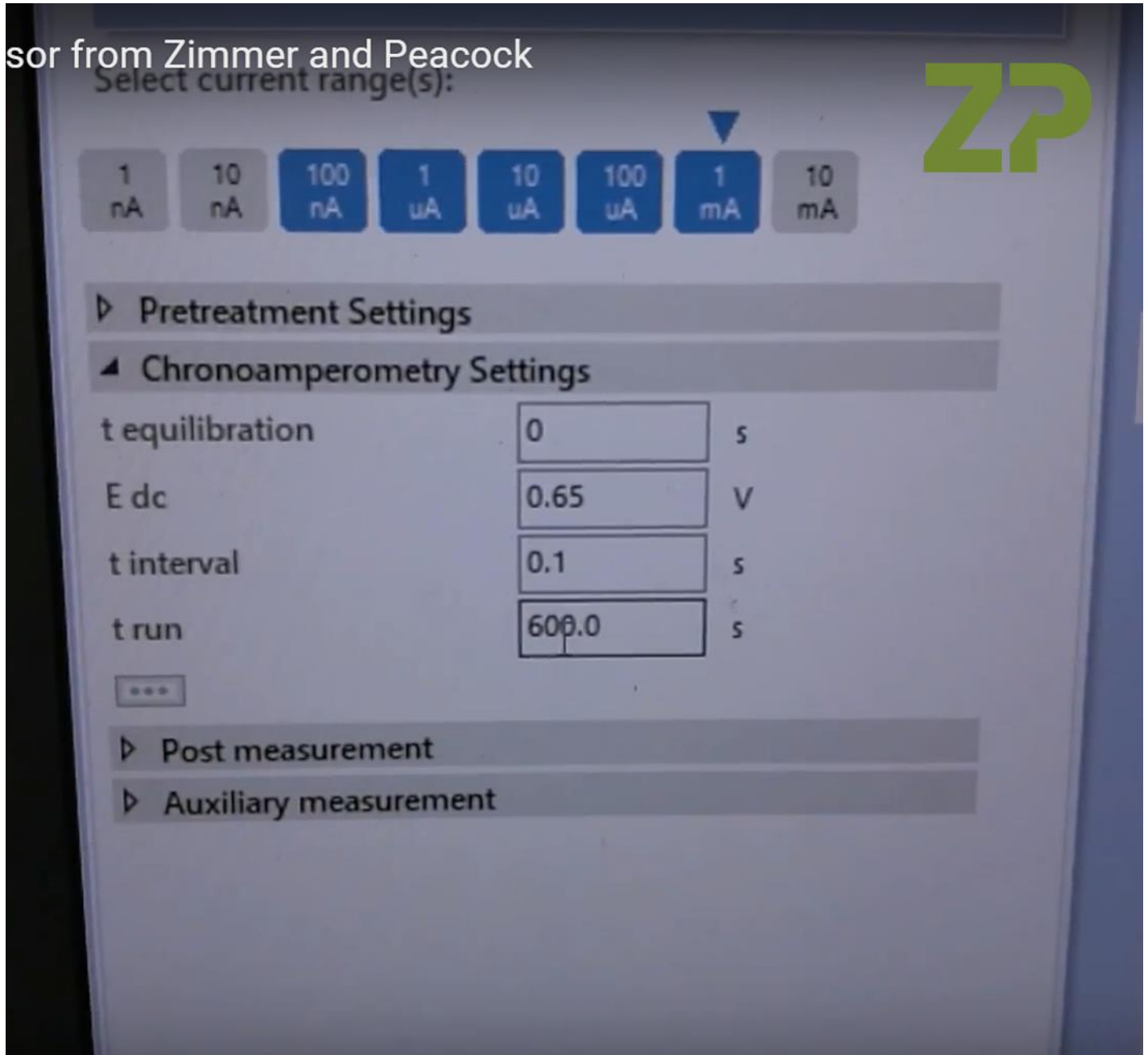
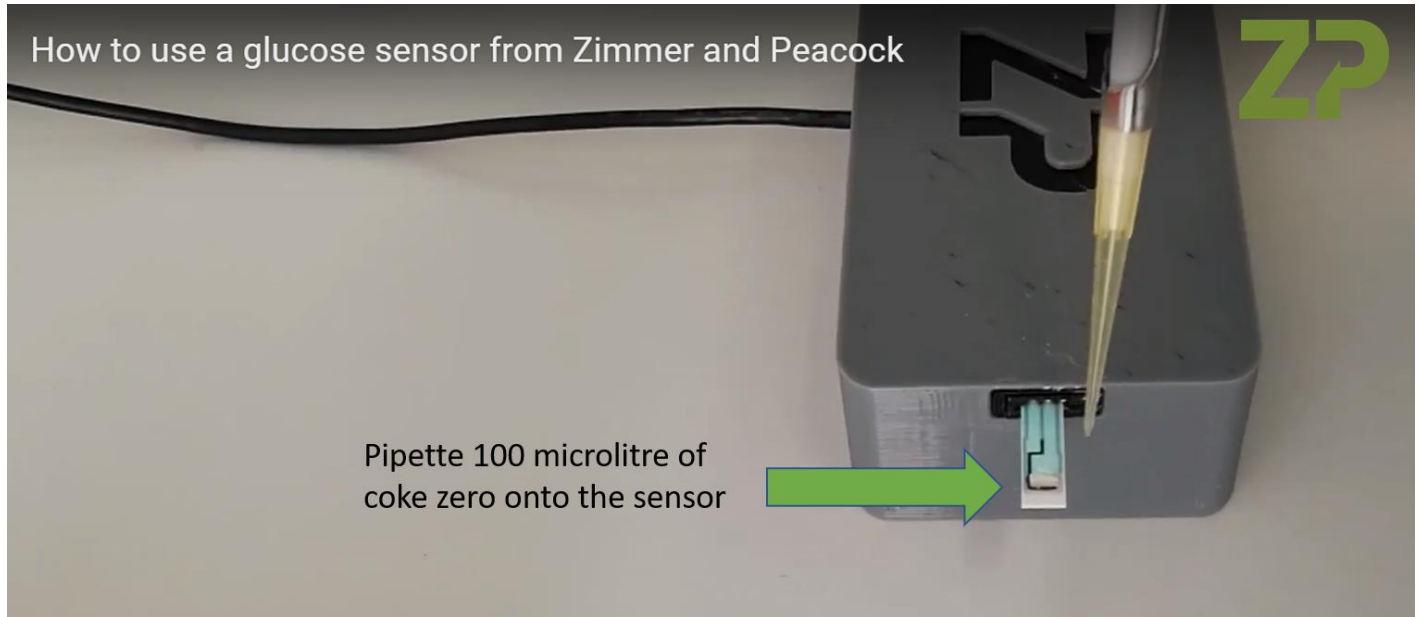


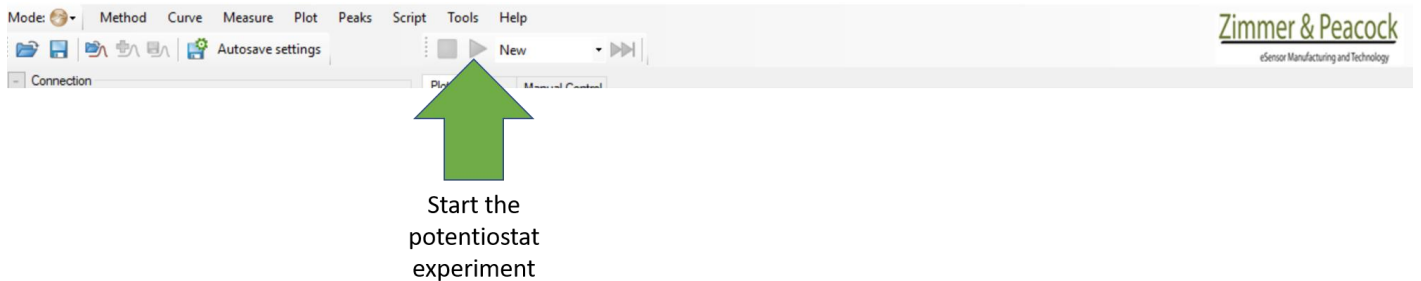
Figure 1.0.2 – Setup of the parameters

- STEP THREE - Adding sample  
 In the first instance add the coke zero as shown below, see Figure 1.0.3



**Figure 1.0.3 – Add the Coke Zero to the electrode**

- **STEP FOUR - Start the potentiostat**  
Please start the potentiostat by clicking the button in the software, see Figure 1.0.4.



**Figure 1.0.4 – Starting the experiment.**

When the potentiostat is first started and coke zero is on the sensor the signal will look like that in Figure 1.0.5.



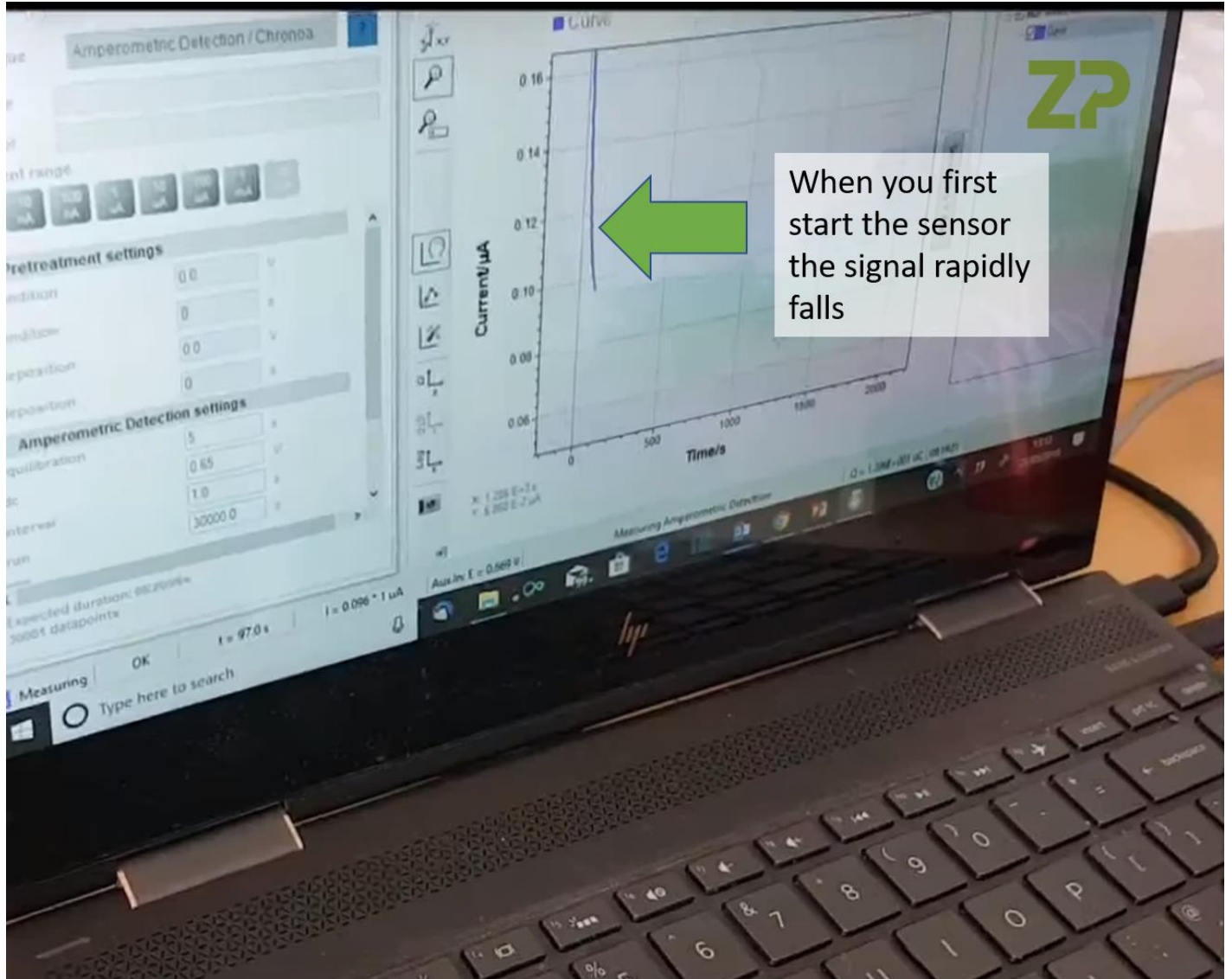
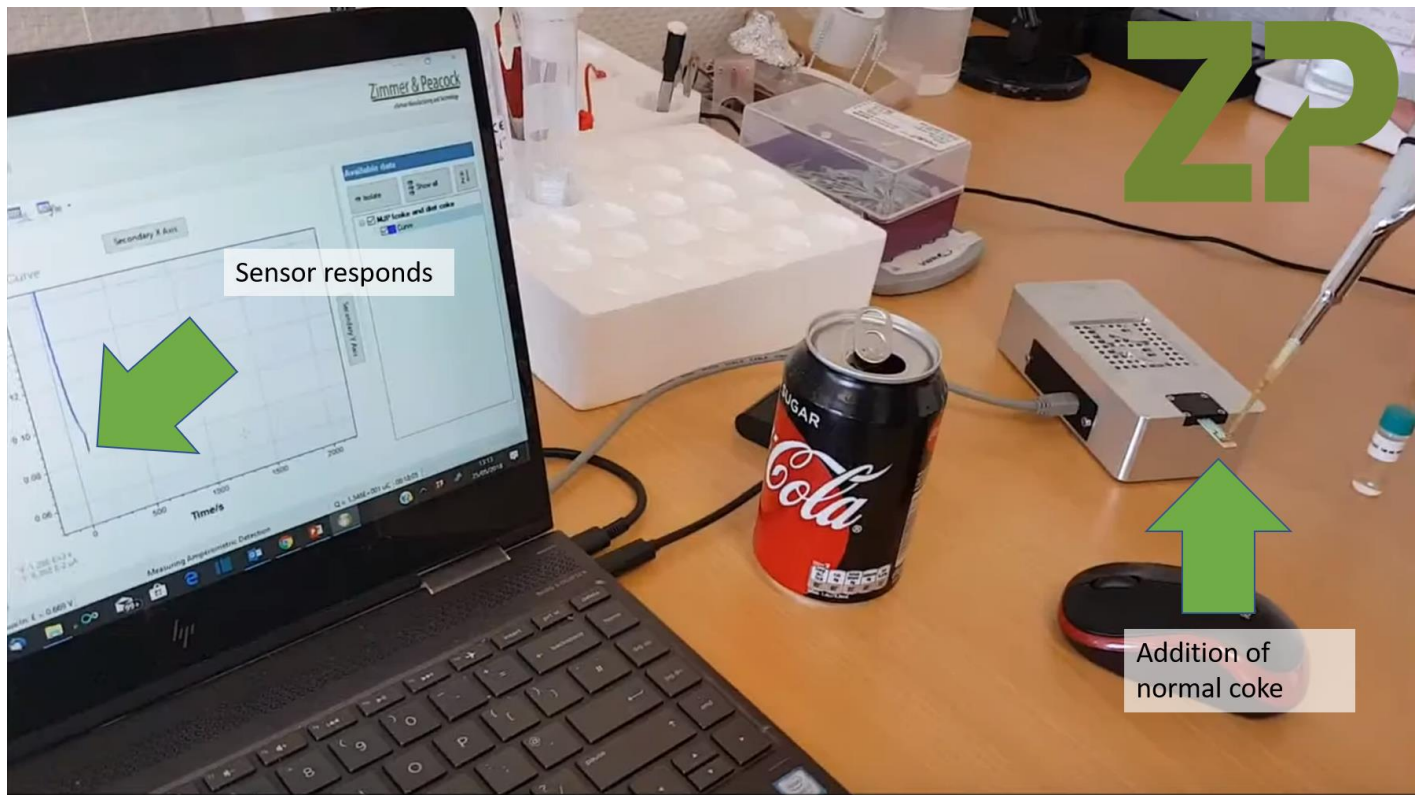


Figure 1.0.5 – Initial signal when the sensor has coke zero upon it.

- STEP FIVE Adding a drop of normal coke

After about 200 seconds add 10 microlitres of normal coke to the 100 microlitre drop of coke zero which is already upon the sensor, see Figure 1.0.6.



**Figure 1.0.6 – Sensor responds as the normal coke is added to the coke zero.**

Very quickly the magnitude of the signal increases, as shown in Figure 1.0.7, this is due to the biochemical reaction in Figure 1.0.0, and the subsequent oxidation of the hydrogen peroxide on the working electrode of the glucose biosensor.

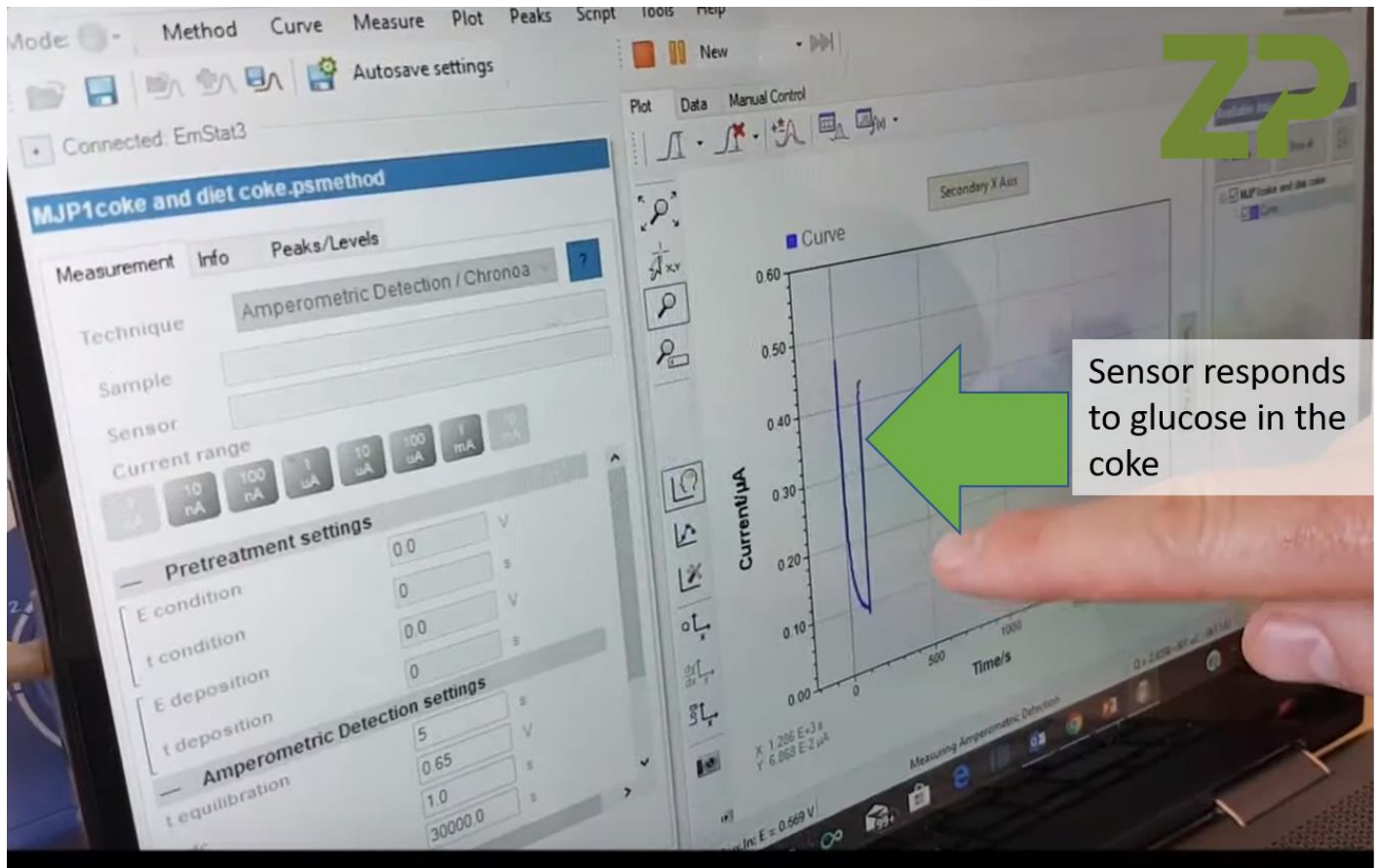


Figure 1.0.7 – Response of the sensor to the glucose in normal coke

## CLEANING AND STORING THE SENSOR

As discussed, the ZP Glucose sensor is a Type One Glucose sensor, the ideal way of storing the sensor is to:

- STEP ONE - Rinse the end of the sensors that was in contact with the coke with water, this can be tap water but ideally we use de-ionized water.
- STEP TWO – Gently draw the water of the sensor using a tissue, we are just trying to gently dry the sensor before we store the sensor.

- STEP THREE – Please store the sensor in a cool dark place a fridge at approximately 5 °C. Please note that we recommend these conditions to extend the life of the sensor, but you can leave the sensor out in the air at room temperature, but to get the longest life from the sensors then please use the recommended storage conditions.

## **CONTACT ZIMMER AND PEACOCK**

If you have any questions regarding this application note please don't hesitate to contact Zimmer and Peacock.

<https://www.zimmerpeacocktech.com/contact/>