CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Fossil fuels used to be one of the major energy sources that have been used by worldwide (Miller, 2015). The combustion of fossil fuel will actually involve both energy consumption and production. However, fossil fuel is a non-renewable energy and will be depleted in the future. To avoid this, researches focus with new ideas in order to replace fossil fuels with energy source which can be unlimited used and environmental friendly. Electrochemical energy is believed that it can replace fossil fuel as a new alternative source of energy. One of the systems for electrochemical energy conversion and storage are batteries.

Battery is a gadget that is made up of two or more electrochemical cells. These electrochemical cells convert stored chemical energy into electrical energy. Battery can be divided into primary and secondary battery. Primary battery is the type of battery which cannot be recharge while secondary battery is the one which is rechargeable. Battery has high energy density which a battery can stores a lot of energy.

In a lithium ion battery, it consists of electrolyte between the cathode and anode. For cathode, lithium cobalt oxide, $LiCoO_2$ is normally used as it has high theoretical specific heat capacity, low self-discharge, high discharge voltage and mechanical stable. (O'Dell & John, 2008) Meanwhile, the materials of anode are constructed from graphite and other carbon material. This is due to their abundance in the nature and good in

electrical conductivity. Graphene also have the ability to swell up to store the lithium ion improving the building charge (Emily, 2013).

Battery use chemical reaction to store energy. In anode, the electrons are built up at the anode due to chemical reactions and this result in an electrical difference between the anode and cathode. Therefore, the electrons rearranged each other to stabilize the electrical difference by repelling each other and move to a region which has lesser electrons. When the circuit is closed, the electrons will be able to move to the cathode by the assistance of electrolyte. However, this electrochemical process will change the chemical of cathode and anode, this causing the termination of generating electrons. Hence, the amount of power of the battery will decrease as time passes and the battery will actually run out and cannot be used. For rechargeable battery such as lithium ion battery, the direction of electron flow will actually change when it is recharged. The electrochemical process happen in reverse, the anode and cathode are restored to their beginning state and the power is being full again.

The function of electrolyte is act as a chemical medium which enables the flow of electrical charge (Xiao, 2015). There are three types of electrolyte, which are solid electrolyte, liquid electrolyte and gel electrolyte. Solid electrolytes are material which has electrons with high mobility, which is suitable for batteries and sensors. Liquid electrolyte is powerful solvents and electrically conducting fluids. The liquefied salts in room temperature are useful for electric battery applications. Meanwhile, gel electrolytes are closely resembled liquid electrolytes that in a flexible lattice framework, as additives are added to increase the conductivity (Freemantle & Michael, 2009).

There are some advantages of using battery compared to other system in elecrtrochemical storage and conversion. Battery has high energy density, which is around 2.63MJ/L, which is 40 times higher than a supercapacitor (0.06MJ/L) (Sharma, 2006). Besides, battery is a portable electronic device as it can be easily installed in any portable electrical appliances. Then, battery also has good charging and discharging performance at low temperature, which enable it to be used safely. Furthermore, battery

is also easily to be obtained and cheap in price, this makes battery has been used widely by common users nowadays.

It cannot be denied that batteries are very important to human lives especially rechargeable lithium-ion battery which is used for most electronic devices. However, there are a few problems raised. When lithium-ion battery is getting too hot and can't cool down quickly enough, creating a chain reaction that generates more and more heat, leading to melting and explode (Tahsin Görgülü, 2015). Every year, there is reported that there are many cases of battery explosion happened in every corner of the world. Meanwhile, leakage of battery electrolyte may happen due to its aging, high temperature and self-discharge (Can and Yih, 2011). Alkaline batteries consist of potassium hydroxide which can cause irritation, which is harmful to human and environment (Malavika, 2004).

It is important to protect the environment from pollution. However, most of the battery that used nowadays is dependant to the high cost catalyst to function and this causes burden to people. Therefore, scientists and researchers are striving hard in order to invent a type of electrical storage which is made up of low cost natural product, using waste to wealth method to transform unwanted materials into a useful one.

1.2 PROBLEM STATEMENT

Nowadays, electrolytes have been used widely in our community as its conductivity is relatively high enough to support most of the portable electrical appliances that can be mentioned. However, the non-biodegradable of the electrolyte became a huge problem that ever seen. The chemicals inside the electrolyte are actually harmful to our environment and human lives. In case, the transformation of electrolyte from non-biodegradable to biodegradable and renewable would be a solution for this case. Hence, biopolymer electrolyte is created to overcome this crisis faced.