

Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation)

(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: JBBC251

Project Title: More sustainable lithium ion battery using alternative materials / 鋰電・持

Project Type: Investigation

To our best knowledge and after thorough literature research, as at 30/06/2022, there are / are no* similar works. If there are, the reference links are as below:

The enhancement our project has made for the existing related products or research is summarized as below:

To obtain replacement for organic solvents in Li-ion battery. We search for possible chemicals from the natural products, scrape food and other sustainable sources.

***Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.**

I. Background

- Provide background information of project and/or state the problem to tackle
- Provide highlights of the **literature review** with the support of pertinent and reliable references
- Provide an overview of work and mention the **research gap that the project is trying to fill**

In lithium-ion battery, organic solvents are essential. PVDF, NMP, alkyl carbonate are three groups of important and common solvents in lithium ion battery in mobile devices and EV. These solvents are derived from petroleum. The use of these solvents is not environment-friendly, because of the nature of the starting materials and the cost to maintain a high pressure.

Alkyl lactate can be a more environmental-friendly option than alkyl carbonate.

Carbon nanotube can be produced from orange peel and other scrape food with high cellulose contents. This kind of carbon nanotube can replace the active carbon (acetylene black) in current Li-ion battery. Acetylene black is also derived from petroleum.

II. Objectives

- State the **aim(s)** of project
- We look into alternatives to these organic materials. We try to obtain replacement from the natural products, scrape food and other sustainable sources.

III. Hypothesis

- Propose an explanation for a phenomenon and stating how the **hypothesis** can be tested by experiments

Alkyl lactate (e.g. ethyl lactate), a group of ester solvents, can be easily produced from alcohol and lactic acid. It could be a replacement to the petroleum-derived alkyl carbonate solvents.

Active carbon from cellulose-rich plants is more conductive and capacitive than petroleum-derived active carbon used in current Li-ion battery.

If the conductivity of these alternatives is comparable to the current choices, they could be more sustainable alternatives of making Li-ion battery.

IV. Methodology

- List out the materials used
- Describe the **experimental protocol** including the set-up of **control experiment** (if any), **repeated experiment** (if any), and its scientific theory
- Indicate with the support of reasons, the **analysis** used in the investigation

Ethyl lactate could be readily purchased. We assemble Li-ion batteries using the alternative chemicals and test on the capacity, charging and discharging power of these alternative batteries.

Carbon nanotube can be produced from orange peel and other scrape food with high cellulose contents. The activation and carbonization can be carried out in inert system (nitrogen-filled chamber) under heat.

The battery will be charged and discharged for several times. The charged and discharged energy amount will be measured in watt-hour (Wh) using capacity tester.

V. Results

- Present the **data** with figures, tables or photos
- **Data analysis** (if any, with emphasis on data reliability and the reproducibility based on statistics)
- Interpret the results and its implication
- Discuss **limitation** and compare with existing related works (if any)
- Discuss the importance or impact of the research and how it is applicable to real problems

(Under investigation)

VI. Conclusion

- Make a **data-driven** conclusion of the project and the way forward of the research
- Justify if the proposed project meets the objective(s)

(under investigation)

Our project is developed based on our school's previous project and the enhancement is as below: