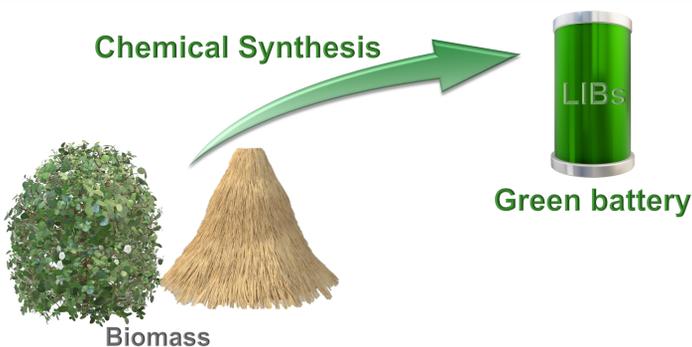
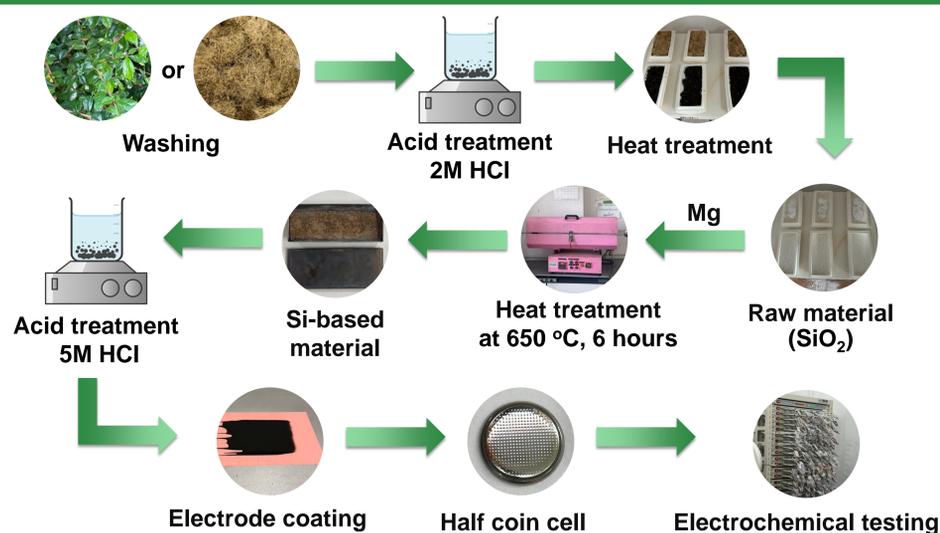


## INTRODUCTION



Lithium-ion batteries (LIBs) are widely used in electronic devices. Because LIBs have a high energy density, are lightweight, and have a long life, they can store a lot of energy in portable devices and vehicles. In LIBs, the anode is often made of graphite. The graphite used in commercial LIBs has the advantages of high energy density, stability, and low expansion during lithium-ion insertion, which reduces the risk of battery damage and can store more energy. However, some disadvantages can be found in graphite, which has a low theoretical capacity of only 372 mAh/g, low voltage, can form lithium dendrites, and can be subject to high-temperature rise, causing a short circuit. Due to the disadvantage of graphite having an electrical capacity of only 372 mAh/g, we want to increase its capacity by using silicon, which has a theoretical electrical capacity of up to 4200 mAh/g, is easily found in nature, and has low toxicity. Another problem is the high production cost because the high price of silicon causes high production costs. This research aims to reduce the cost of silicon production by using biomass as a raw material to synthesize Si-based materials. In this research, chahokkien leaves and rice straw were used as materials for the preparation of Si-based

## METHODOLOGY



## RESULTS AND DISCUSSION

### XRD Patterns :

Phase identification

- XRD patterns show
  - Cubic Si at  $2\theta$  (degree) = 28°, 47° and 56°
  - amorphous SiO<sub>2</sub> at  $2\theta$  (degree) = 22°

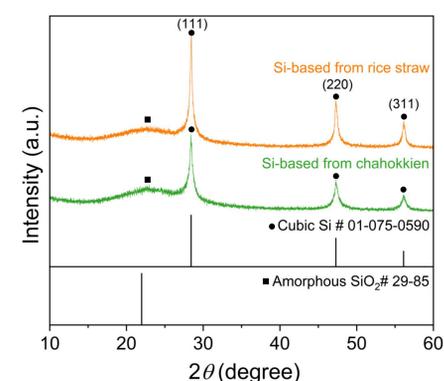


Fig 1. XRD patterns of Si-based materials

### SEM :

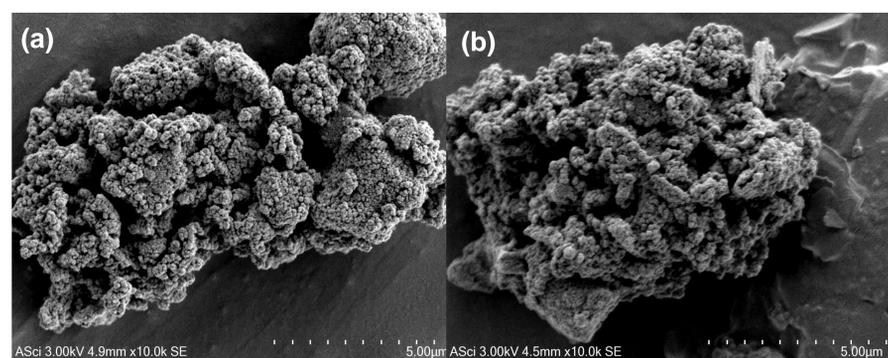


Fig 2. SEM images of Si-based materials with different raw materials of (a) chahokkien leaves and (b) rice straw

### TEM :

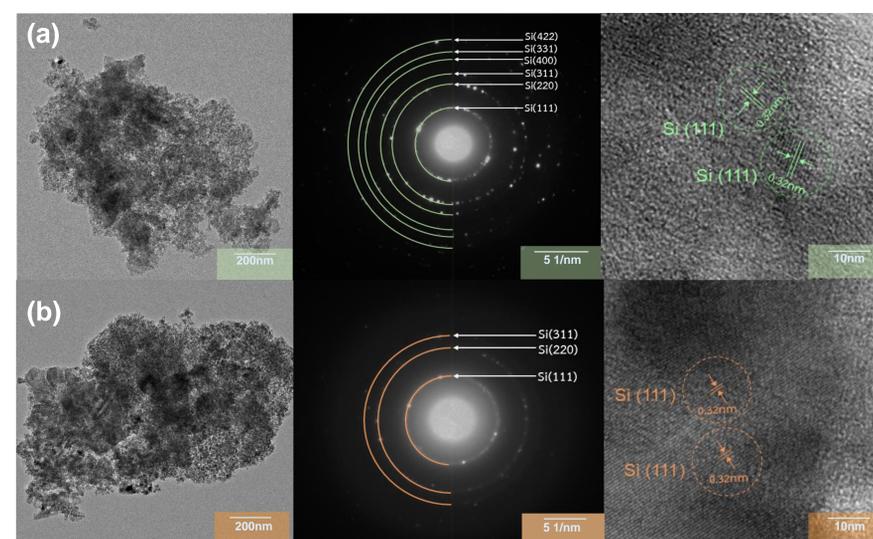
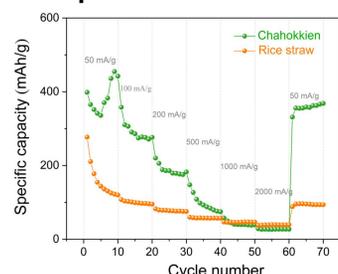


Fig 3. TEM images of Si-based materials with different raw materials of (a) chahokkien leaves and (b) rice straw

- SEM and TEM display accumulated nanoparticles clusters
- Ring patterns show Si but not SiO<sub>2</sub> (being of amorphous)
- HRTEM display Si fringes

## Electrochemical performance

### Rate performance:



### Cycle stability test:

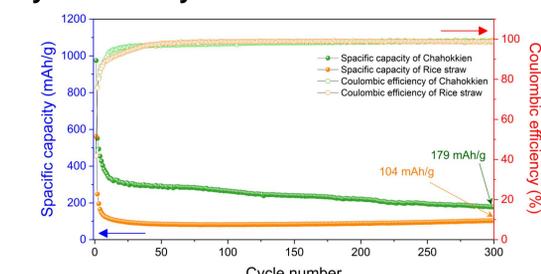


Fig 4. Rate performance of Si-based materials

Fig 5. Cycle stability of Si-based materials at current density of 100 mA/g

- Rate performance and cycle stability of synthesized materials electrode at a current density of 100 mA/g for 300 cycles, chahokkien leaves has the specific capacity of 179 mAh/g and rice straw have specific capacity 104 mAh/g

### Cyclic voltammetry:

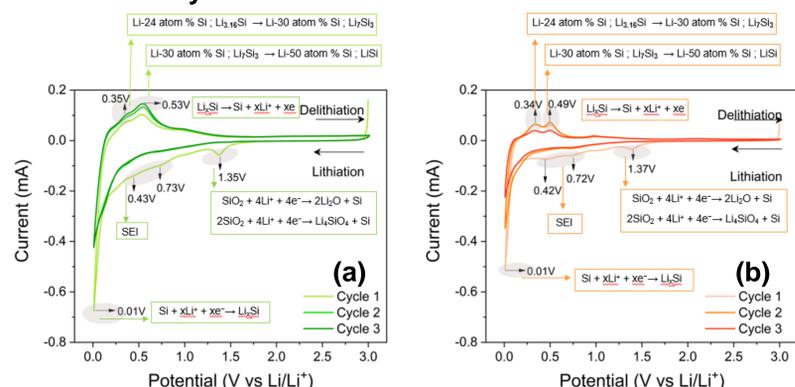


Fig 6. Cyclic voltammetry of Si-based materials with different raw materials of (a) chahokkien leaves and (b) rice straw

- The CV curve peak position of the two electrode materials is similar, indicating that the electrochemical reactions are the same

## CONCLUSION

Si-based material can be prepared from chahokkien leaves and rice straw from experimental results. XRD patterns showed a cubic Si phase and an amorphous SiO<sub>2</sub> phase. SEM and TEM showed morphology clusters of nanoparticles. The electrochemical performance of the Si-based material from chahokkien leaves and rice straw showed good cycle stability and rate performance. The capacity of Si/SiO<sub>2</sub> from chahokkien leaves (179 mAh/g for 300 cycles at 100 mA/g) was higher than that of Si/SiO<sub>2</sub> from rice straw (104 mAh/g for 300 cycles at 100 mA/g). Therefore, the experimental results indicate that we can prepare Si-based anode materials for LIBs to enable large-scale, energy-efficient, eco-friendly, and cost-effective.

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