Supporting Information

Low-cost perovskite solar cell fabricated using expanded graphite back contact and electronically conducting activated carbon as hole transporting material

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1. Cost analysis of synthesis of active carbon

Since coconut shells is a waste material in Sri Lanka, we obtained them without any cost. Carbonization was done by simply burning the coconut shells in a covered pot without using electricity.

1.1 Cost of disc milling coconut charcoal

Parameter	Value	unit
Capacity of the disc mill	5	g
Power consumption of the disc mill	0.75	kW
Time taken to disc mill charcoal	300	s
Energy required to disc mill charcoal (Q_1)	0.0125	kWh g^{-1}

1.2 Cost of activating charcoal

1.2.1 Cost of heating the charcoal

Parameter	Value	Unit
Capacity of the furnace	10	g
Heating temperature	950	°C
Power consumption of the furnace	1.0	kW
Time taken to heat the furnace from room temperature to 950 °C	1500	s
Time kept charcoal at 950 °C	1200	s
Total energy required (Q_2)	0.075	kWh g^{-1}

1.2.2 Cost of quenching charcoal in distilled water to make activated coconut shell charcoal

Parameter	Value	Unit

Amount of distilled water required to quench the charcoal	250	mL g^{-1}
Cost of distilled water	0.75	kWh L^{-1}
Cost of Distilled water for quenching charcoal (Q_3)	0.19	kWh g^{-1}

1.2.3 Cost for drying active charcoal

Parameter	Value	Unit
Capacity of hotplate	10	g
Drying temperature	100	°C
Drying time	12	hours
Power consumption of the hot plate	0.16	kW
Energy for drying active coconut shell charcoal (Q_4)	0.192	kWh g^{-1}

Energy required to synthesis activated coconut shell charcoal (Q_C),

$$Q_C = Q_1 + Q_2 + Q_3 + Q_4 \quad \text{(S1)}$$

$Q_C = 0.470$ kWh g^{-1}

Electricity cost of Sri Lanka is 0.04 USD kWh^{-1} [1]. Hence, the cost to synthesis activated coconut shell charcoal is around 0.02 USD g^{-1}

1.3 Price comparison of CSAC and Spiro-OMeTAD

Material	Price (USD g^{-1})
CSAC	0.02
Spiro-OMeTAD	660 [2]

2. Cost analysis of synthesis of expanded graphite form graphite

Since we used discarded graphite attached rocks, it did not cost us any money to obtained raw expanded graphite

2.1 Acid and heat treatment to synthesis intercalated graphite

Parameter	Value	Units
Conc.H_2SO_4 amount required	24	mL g^{-1}
Price of conc. H_2SO_4 (P_1)	0.008 [3]	USD mL^{-1}
Conc. HNO_3 amount required	4	mL g^{-1}
Price of conc. HNO_3 (P_2)	0.06 [4]	USD mL^{-1}
Capacity of furnace	5	g

Heating temperature	600	°C
Time taken to heat to 600 °C form room temperature	600	s
Time kept at 600 C	600	s
Power consumption of the furnace	0.65	kW
Energy required to synthesis expanded graphite(Q_5)	0.043	kWh g^{-1}

Cost to synthesis expanded graphite (Q_{EG}),

$Q_{EG} = 24P_1 + 4P_2 + 0.04Q_5$ (S2)

$Q_{EG} = 0.43$ USD g^{-1}

2.2 Price comparison of expanded graphite and gold

Material	**Price (USD g^{-1})**
Expanded graphite	0.43
Gold	132.5 [5]

References

(1) Sri Lanka electricity prices, June 2022 | GlobalPetrolPrices.com https://www.globalpetrolprices.com/Sri-Lanka/electricity_prices/ (accessed Mar 9, 2023).

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