

Tafila Technical University (TTU) online workshop- Report

Event type	Workshop
WP Number	WP3, WP7
WP Leader	NTUA, HTU
Event date	27-07-2022
Number of Participants	92
Total number of pages	10

Project Coordinator

Prof Ahmed Al-Salaymeh,

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1 Event Description

Tafila Technical University (TTU) from Jordan conducted an online workshop on 27th of July 2022. The 1.5 -hour workshop was conducted via ZOOM and titled “Lithium Sulfur Batteries in Automobiles”.

The workshop started with a welcoming speech and an overview of the nature of the project, its objectives and the partners working on it by the project coordinator, Prof. Ahmed Al-Salaymeh from The University of Jordan.

- “Lithium Sulfur Batteries in Automobiles” by: Dr. Hesham Al Salem

A discussion panel was opened for participants.

2 PPTs

- ECO-CAR in brief:

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3 Poster



ECO-CAR Workshop

Lithium Sulfur Batteries in Automobiles

Presented by: Tafila Technical University (TTU)



Wednesday, July 27, at 15:00 (Amman time)

14:45-15:00 : Registration

15:00-15:15: Welcoming Speech, by:
Prof. Ahmed Al-Salaymeh, General Project
Coordinator at The University of Jordan

15:15-16:15 : Lithium Sulfur Batteries in
Automobiles

16:15-16:30 : Discussion and Closing



Presenter: Dr. Hesham Al Salem, Tafila Technical University (TTU)



4 ZOOM participants list

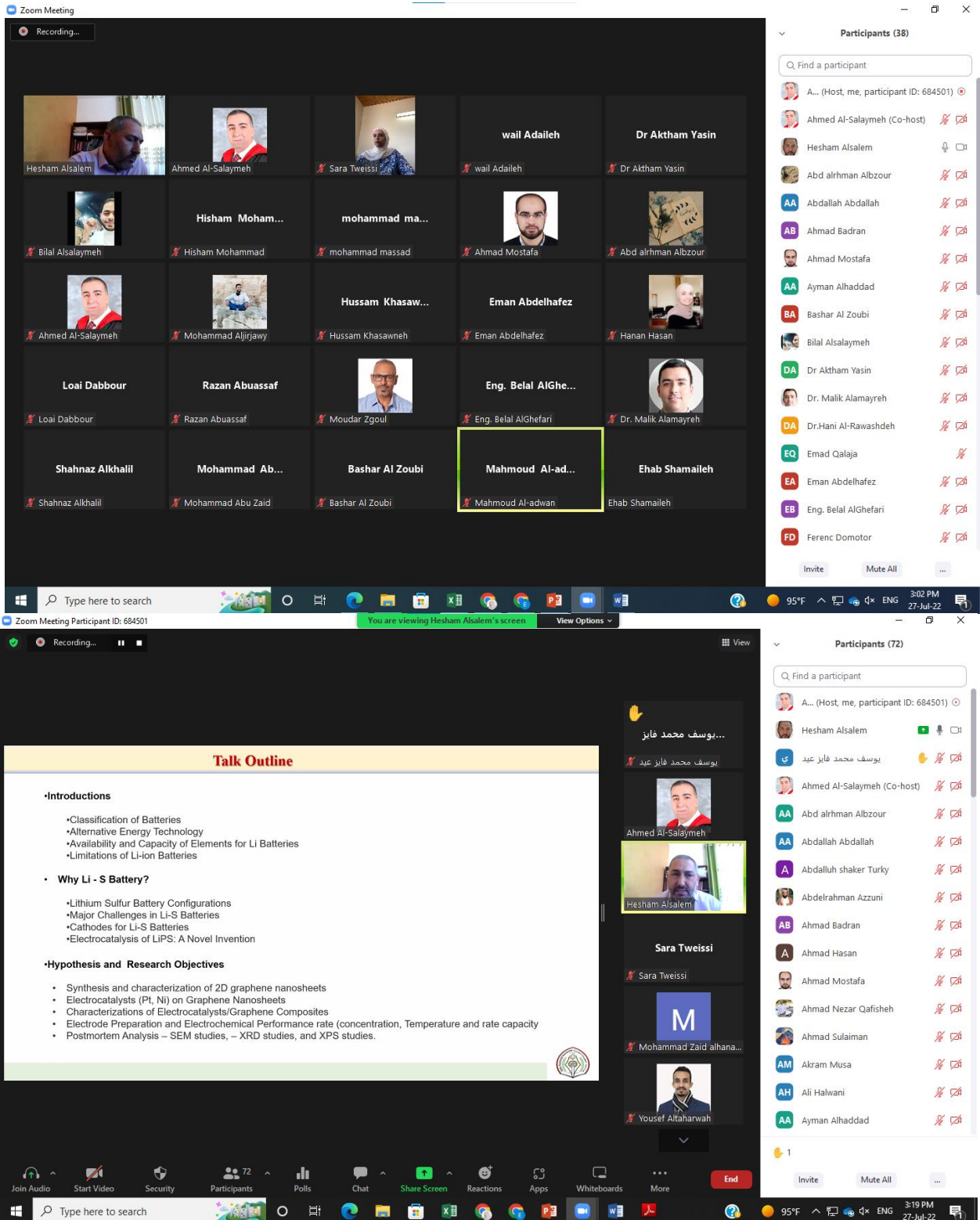
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ERASMUS+ PROGRAMME Project Number: 618509-EPP-1-2020-1-JO-EPPKA2-CBHE-JP

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5 Photos



The image shows two screenshots of a Zoom meeting. The top screenshot displays a grid of 20 participants in a 4x5 layout. The bottom screenshot shows a 'Talk Outline' slide with the following content:

Talk Outline

- Introductions**
 - Classification of Batteries
 - Alternative Energy Technology
 - Availability and Capacity of Elements for LI Batteries
 - Limitations of Li-ion Batteries
- Why Li - S Battery?**
 - Lithium Sulfur Battery Configurations
 - Major Challenges in Li-S Batteries
 - Cathodes for Li-S Batteries
 - Electrocatalysis of LIPS: A Novel Invention
- Hypothesis and Research Objectives**
 - Synthesis and characterization of 2D graphene nanosheets
 - Electrocatalysts (Pt, Ni) on Graphene Nanosheets
 - Characterizations of Electrocatalysts/Graphene Composites
 - Electrode Preparation and Electrochemical Performance rate (concentration, Temperature and rate capacity)
 - Postmortem Analysis – SEM studies, – XRD studies, and XPS studies.

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Availability and Capacity of Elements for Li Batteries

(a) Availability

Element	Values	Colors
Li	Fraction of Earth's Crust: 6.5%	Type B Conversion Anodes
Na	5 Year Price Range (USD lb ⁻¹): 0.40E-4 to 2971-0-0	Type B Conversion Cathodes
S		Commonly used Transition Metals for Interconversion Electrodes

(b) Charge Capacity

Element	Values	Colors
Li	Gravimetric Capacity (mAh/g ⁻¹): 3862	Type B Conversion Anodes
Na	Volumetric Capacity (mAh/cm ³): 1878	Type B Conversion Cathodes
S		Commonly used Transition Metals for Interconversion Electrodes

- Battery-Electropositive vs. Electronegative elements
- Li has the lowest reduction potential – Possible to have highest cell potential, when it combined with electronegative elements (Ex.: Li vs F >6.0V)
- Li is the light third element with smallest ionic radii
- Lithiated metal oxides are acting as cathodes against Li (Ex.: LiCoO₂)
- The ionic diffusion in the solid electrodes is often the rate-limiting factor for battery power Performance

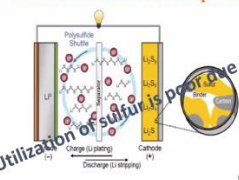
Nitta et al. Materials Today 18.5 (2019): 252

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Lithium Sulfur Battery Configurations

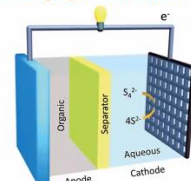
1. Solid sulfur-carbon composites based Li-S system



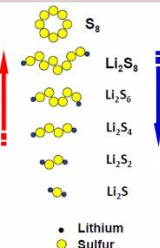
Utilization of sulfur is poor due to pore clogging

Cathodic rxn.: $S + 2e^- \rightarrow S^{2-}$
 Anodic rxn.: $2Li \rightarrow 2Li^+ + 2e^-$
 Overall rxn.: $2Li + S \rightarrow Li_2S, \Delta G = - 439.084kJ$

2. Liquid lithium polysulfide's based Li-S system



Li_2S_8 : 209 mAh/g-S, Li_2S_4 : 418 mAh/g-S
 Li_2S_2 : 840 mAh/g-S, Li_2S : 1675 mAh/g-S



Charge process (upward arrow)
 Discharge process (downward arrow)

- Lithium
- Sulfur

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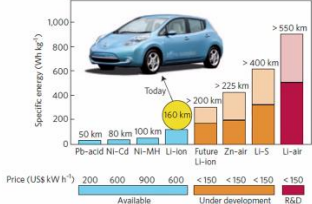
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Why Li - S Battery?

- Extremely Low cost (Sulfur, one of the most abundant elements in earth's crust)
- Environmentally safer(nontoxicity, unlike cobalt metal or nickel or manganese)
- High theoretical capacity(1675mAh/g)

High capacity is based on the **reversible conversion reaction** of sulfur to form lithium sulfide (Li₂S) by using **two electrons per sulfur atom** (one or less than one electron per transition-metal ion in insertion-oxide cathodes in Li-ion)



Technology	Specific energy (Wh/kg)	Price (US\$/kWh)	Status
Pb-acid Ni-Cd	50 km	200	Available
Ni-MH	80 km	600	Available
Li-Ion	100 km	900	Available
Future Li-ion	> 200 km	600	Under development
Zn-air	> 225 km	< 150	Under development
Li-S	> 400 km	< 150	Under development
Li-air	> 550 km	< 150	R&D

Participants (73)

Find a participant

- A... (Host, me, participant ID: 684501)
- Hesham Alsalem
- Ahmed Al-Salaymeh (Co-host)
- Abd alrham Albzour
- Abdallah Abdallah
- Abdalluh shaker Turkey
- Abdelrahman Azzuni
- Ahmad Badran
- Ahmad Hasan
- Ahmad Nezar Qafisheh
- Ahmad Sulaiman
- Akram Musa
- Ayman Alhaddad
- Bashar Al Zoubi
- Bilal Alsalaymeh
- Dirar Hjouj
- Dr Aktham Yasin

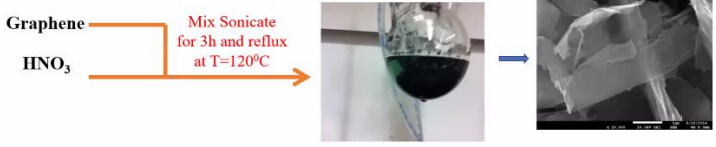
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Step #2: Electrocatalysts (Pt, Ni) on Graphene Nanosheets

❖ To uniformly disperse metal particles on graphene layers, prepare graphene for adding these metal particles by creating an active functional groups in the graphene sheet

Graphene + HNO₃ → Mix Sonicate for 3h and reflux at T=120°C → Metal/Graphene composites



✓ SEM: Randomly oriented graphene sheets

Polyol reduction process

- Add FGn + Ethylene Glycol
- Sonicate for 2-3 h.
- Add Ni(NO₃)₂·6H₂O or H₂PtCl₂·6H₂O and stir for 3-4 h.
- Reflux the solution at 190 °C in AR atm for 3h.
- Filter the solution and wash with DI water.
- Dry under vacuum at 70 for 7 h.

Participants (72)

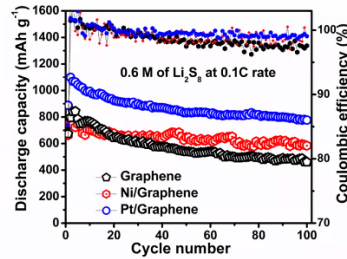
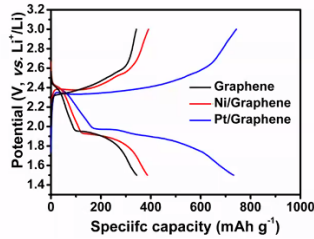
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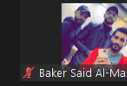
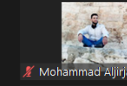
Zoom Meeting

Recording...

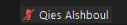
Step #3: Electrochemical Performances



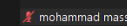
Electrochemical properties	Type of Electrode		
	Graphene	Ni/Graphene	Pt/Graphene
Capacity at 100 th cycle (mAh g ⁻¹)	460	580	789
Coulombic efficiency at 100 th cycle (%)	97.3	98.2	99.0
Discharge plateau (V)	1.94	1.94	1.97
Polarization difference at 50% of DOD (V)	0.51	0.50	0.44



Qies Alshboul



mohammad ma...



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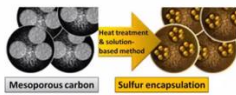
You are viewing Hesham Alsaalem's screen

View Options

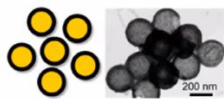
Recording...

View

Literature: Cathodes for Li-S Batteries



Spherical ordered micro / mesoporous carbon



Porous hollow carbon/sulfur composites

Carbon-based sulfur composites have shown outstanding progress in Li-S battery performance

- > Poor adsorption
- > Volume changes
- > Slow reaction kinetics

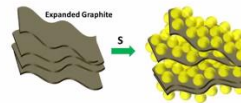
- Simultaneously,
- ✓ high active material loading
 - ✓ high specific capacity
 - ✓ long cycle stability could not be obtained with any single composite material



Porous carbon nanofibers/sulfur composites



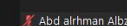
Hollow carbon nanotubes/sulfur composites



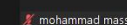
Expanded graphite oxides with inserted S within the carbon layers



Abd alrhman Al...



mohammad ma...





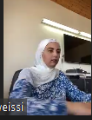

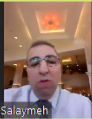

Join Audio Start Video Security Participants Polls Chat Share Screen Pause/Stop Recording Breakout Rooms Reactions Apps Whiteboards More End

Type here to search

3:40 PM 27-Jul-22

Zoom Meeting Participant ID: 684501

Recording...

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 Sara Tweissi	Shahnaz Alkhalil Shahnaz Alkhalil	wail Adaileh wail Adaileh	Dr Aktham Yasin Dr Aktham Yasin	Hisham Moham... Hisham Mohammad
عتبة فايز متعب الق... عتبة فايز متعب القاطنة	Loai Dabbour Loai Dabbour	Bashar Al Zoubi Bashar Al Zoubi	 Muhand Alhawartha	 Ahmed Al-Salaymeh
 Ziad Al-Khatib	يوسف محمد فايز عيد يوسف محمد فايز عيد	Ehab Shamaileh Ehab Shamaileh	Emad Qalaja Emad Qalaja	Ayman Alhaddad Ayman Alhaddad
Raghad Dababseh Raghad Dababseh	Ferec Ferenc Dorr	From Hisham Mohammad to Everyone جهودكم مشكورة	fa Moham... med	Najat Almasarwah Najat Almasarwah

Join Audio Start Video Security Participants 51 Polls Chat 2 Share Screen Pause/Stop Recording Breakout Rooms Reactions Apps Whiteboards More End

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6 Video

<https://www.youtube.com/watch?v=7CLwr0ykM78>

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