RCLIB
(1.11.2023 – 30.10.2025)

LEAP-RE

Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

Pillar-1 project

The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

Recycling of the cathodes, based on carbon nanotubes and conducting polymers, from spent rechargeable Li batteries - RCLIB

LEAP-RE

Consortium

National Institute of Materials Physics (NIMP) – Romania (Mihaela Baibarac)

IT Center for Science and Technology (CITST) – Romania (Oana Cramariuc)

Istituto Nazionale di Fisica Nucleare (INFN) – Italy (Stefano Bellucci)

Mohammed VI Polytechnic University (UM6P) – Morocco (Saadoune Ismael)

Badji Mokhtar University (UBMA) – Algeria (Ouanassa Guellati)

University Cadi Ayyad (UCA) – Morocco (Rachid Hakkou)

Aim of the project

Recycling of cathodes from spent RLIBs of the type (-) Li/ the PDPA/CNs composite (+), by the fabrication of new electrodes containing the CPd/CNs, CPd/OCN, CPd/CNs/PVDF & CPd/Biochar/ CNs composites (CPd and OCN stand for CP in doped state and oxidized CN, respectively) as active materials for supercapacitor (SC) cells and RLIB

Relevance vs MARs – MARS 2

The development of a technology to separate the constituents of the cathodes from spent RLIBs

New methods for preparation of the active materials for new energy storage devices using the constituents from spent RLIBs

The optimization of electrodes and their testing in SCs and RLIBs

Assessment of needs and resources at country and/or regional level

Project acronym

LEAP-RE

Key challenges addressed by the project

1. *Recovering of the cathodes, containing PDPA/CNs composite, from spent RLIBs and elaboration of a technology for the separation of the constituents of these electrodes*
2. *Preparation of: a) the composites based on a1) (CP)d/CN, (CP)d and PVDF; a2) (CP)d/CNO and a3) (CP)d /Biochar/CN, where CP = PDPA and b) the fibers based on (CP)d/CN, (CP)d and PVDF via classical methods and electrospinning*
3. *Optimisation of the performance of composites as active material for the electrodes of RLIBs and SCs*
4. *Exploitation (IPR, business, networking, etc)*

Expected results :

- ***Mid-term expected results (mid 2024)***
  - *Recovery of constituents of spent RLIB cathodes*
  - *Synthesis of composites: PDPA/CN/PVDF & PDPA/OCN*
  - *Preparation of fibers PDPA/CN/PVDF*
  - *Synthesis of composites PDPA/Biochar/CN*
  - *Characterization and first evaluation of the electrodes' performance in SCs &RLIBs*
- ***End of project expected results (2025)***
  - *Optimized RLIBs and SCs*
  - *Revaluation of the electrodes performance in SCs &RLIBs*
  - *Business plan for future exploitation*
  - *Patent application*

Project acronym

LEAP-RE

Expected outcomes

What could be the impact of the project at 2030 on the economy and/or society in case of scaling up the results of the project ?

Time frame	Impact level and size	MAR2 related impact
Short term	Scientific impact	- New methods for cathodes recycling and reuse of compounds other than the traditional metallurgic processing for Li recycling; - Production of novel composite materials; - Preparation of electrodes for batteries and supercapacitors via conventional methods and electrospinning.
Short term	Capacity building	- Closer collaboration between researchers, innovators and funders; - Improved professional competences and expertise (including R&D, managerial, business, communication) of the team member; - Closer institutional cooperation between Africa and Europe.
Medium term	Societal and policy impact	- Creation of jobs through use and reuse of EOL components; - Creation of policy incentives to encourage collection and reuse of rechargeable Li batteries for materials other than the traditional Li recovery; - Increased awareness for the economic and environmental effects involved with collection and reuse of Li batteries.
Medium term	Technological impact	- Recycling technology will become more efficient through uptake of the project's results; - Manufacturing of new cathodes for batteries and SC.
Medium term	Business	- The SME involved in the project will exploit the project results and the identified markets both locally and through the collaboration of the industrial partners who offered support letters (e.g., specialized electrospun fibers, IPR)
Long term	Economic	- Reduced production costs and increased recovery rates; - Transition from a linear to a circular economy.
Long term	Environmental impact	- Reduced materials used for new products; - Incentive for increased collection of Li batteries; - Decrease in heavy metals and hazardous chemicals waste.
Long term	Business	- Increased economic gain through the uptake by main consumers of Li batteries and SC: automotive, marine, industrial, and power.

Project acronym

LEAP-RE

Which main risks could you face during the project implementation ?

Risk identified	Probability	Impact	Contingency plan
The weight of CNO resulted in WP1 after the separation of the constituents of spent RLIB cathodes	*Medium*	*Low*	*Mitigate by the achievement of various oxidation process of CN resulted after the separation of the constituents of spent RLIB cathodes*
SCs cells having electrodes containing the composites PDPA/CN/PVDF,PDPA/CN, PDPA/OCN, PDPA/Biochar/CN show a low discharge capacitance in comparison with the cell (−) the PDPA-salt/SWNT composite// the PDPA-salt/SWNT composite (+)	*Medium*	*Medium*	*Mitigate by interaction of the composites PDPA/CN/PVDF, PDPA/CN, PDPA/OCN with various acides (e.g. H_2SO_4, $H_3PMo_{12}O_{40}$, etc.). This interaction will lead to an increase of the dopage degree of PDPA and its conductivity. The variation of the ratio between the constituents of the composite materials is also envisaged.*
RLIBs having electrodes containing the composites PDPA/CN/PVDF,PDPA/CN, PDPA/OCN, PDPA/Biochar/CN show a low capacity in comparison with the cell (-) Li// PDPA-salt/SWNT composite (+)	*Medium*	*Medium*	*Mitigate by the interaction of the composites PDPA/CN/PVDF, PDPA/CN, PDPA/OCN with various acides (e.g. H_2SO_4, $H_3PMo_{12}O_{40}$, etc.). This interaction will lead to an increase of the dopage degree of PDPA and its conductivity. The variation of the ratio between the constituents of the composite materials is also envisaged.*
Optimization of SCs cell in order to obtain high discharge capacitance	*Medium*	*Medium*	*Mitigate by testing of electrodes prepared in this project both in symmetrical and asymmetrical SCs cells as well as the variation of the active material weight in the mass of the two electrodes will be carried out.*
Optimization of RLIBc in order to obtain high capacity	*Medium*	*Medium*	*The variation of the active material weight in the mass of the cathodes will be carried out*
Dissemination of results by the physical participation at the national/international conference, kick-off meeting, closing meeting, trainings for young researchers and workshop, as a consequence of the geopolitical situation and/or the pandemic situation	*Medium*	*Medium*	*Mitigate by the choice of the national/international conference which are organized in hybrid regim (including on-line regim). In the case of the kick-off meeting, closing meeting, trainings for young researchers and the steering committees and workshop, NIMP will considered the organization of events in on-line regime (video conferences)*
Delay in purchasing the chemicals	*Low*	*Low*	*All institutions have a department that are in charge with these activities and taking advantage of their experience will avoid this kind of risks.*

Project acronym

LEAP-RE

Contribution of the project to AU – EU R&D partnership

- *All partners will strengthen its national and international collaboration and mutual understanding towards new avenues for common research initiatives and high impact publications.*
- *In Morocco and Algeria, the acquired expertise will aid UM6P, UCA and UBMA partners to become involved in the avenues opened by the countries' natural resources which kept growing in recent years.*
- *Special attention will be given to a high exchange of scientific knowledge between the parties involved by achievement of trainings focused on the nanomaterials used as electrode active materials in SCs and RLIBs, separation methods of constituents from spent cathodes of RLIB, electrospining techniques for African specialists.*
- *At institutional level, initial steps towards a future commercial exploitation in WP6 will have an economic impact on both the involved SME and on potential commercialization through spin-offs.*

Interest of Consortium members in participating in LEAP-RE clustering activities

The project will comply with an open science principle and will thus share through various dissemination means:

- *The development of a technology to separate the constituents of the cathodes from spent RLIBs*
- *New methods for preparation of the active materials for new energy storage devices using the constituents from spent RLIBs*
- *The optimization of electrodes and their testing in SCs and RLIBs*

THANK YOU

CONTACT US FOR MORE INFORMATION

www.leap-re.eu

contact@leap-re.eu

@leapRE_EU

The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.