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GRANT AGREEMENT No. 875613

HIGREEW – Deliverable Report

D2.4 – Report on single cell testing and performance

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Publishable summary

The HIGREEW project sets out to design, build, and demonstrate a prototype of a new high energy density generation of Aqueous Organic Redox Flow Battery (AORFB) based on a water-soluble low-cost organic electrolyte and featuring low-cost components and long service life.

The development at materials level is fundamental in the achievement of the project objectives. However, the interaction of materials when integrated in a battery is a critical step on the adequate functioning of a redox flow battery. Compatibility of materials is behind key parameters such as the durability of the battery and the performance. HIGREEW proposes that membrane-electrolyte and electrode-electrolyte interactions are to be considered during the design and selection of materials.

After an initial stage for development and selection of most promising electrolyte, membrane, electrodes and bipolar plates according to fundamental characterization of those materials, the evaluation in single cell serves to corroborate their value. Single cell testing is proposed as intermediate step prior to stack development and prototype construction. Cell testing would unveil parameters such as the electrochemical stability, the efficiency of the charge-discharge process, the capability to provide, store and retain energy, etc.

In summary, experiments described in this report are intended to understand the behavior of components together throughout the window of temperature, voltage, state-of-charge considered for operation of the battery. The aim is to validate the materials at cell level and define the requirements and preliminary protocols for later operation of HIGREEW battery.

This report compiles the cell testing experiments carried out to confirm the suitability of developed materials to fulfill project objectives according to protocols defined in WP1.

It has been confirmed that a set of components electrolyte-electrode-membrane developed in the first stage fulfills the project targets. Thus, highly soluble active materials that can lead to concentrations over 2 mol of electrons per liter and render high energy density (40 $Wh \cdot L^{-1}$) electrolytes and a cell voltage of ca. 1.3 V have been implemented in single cell with low-capacity decay (0.01%$\cdot cycle^{-1}$) attributed to the anolyte-catholyte disbalance, confirming its long-term stability. In addition, a highly stable system, with negligible capacity decay based on low-cost electrolyte-membrane-electrode tandem has been achieved. Although the latter cannot outperform VRFB in terms of energy density, cost and performance-wise, it is presented as a competitive solution for AORFBs. Evaluation of HIGREEW membranes and electrodes stability was confirmed attending to the lack of degradation evidence on the performed experiments. Further, evaluation of the materials and confirmation of this stability at stack and prototype level will take place in following stages. Cell testing evaluation of alternative set of components developed in WP2 is also included in this report.

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Project partners:

#	Partner	Partner Full Name
1	CICe	CENTRO DE INVESTIGACION COOPERATIVA DE ENERGIAS ALTERNATIVAS FUNDACION, CIC ENERGIGUNE FUNDAZIOA
2	GAMESA	GAMESA ELECTRIC SOCIEDAD ANONIMA
3	UAM	UNIVERSIDAD AUTONOMA DE MADRID
4	CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS
5	C-TECH	C-TECH INNOVATION LIMITED
6	HEIGHTS	HEIGHTS (UK) Limited (Termination report ongoing)
7	UWB	ZAPADOCESKA UNIVERZITA V PLZNI
8	PFES	PINFLOW ENERGY STORAGE, S.R.O.
9	UNR	UNIRESEARCH BV
10	SGRE	SIEMENS GAMESA RENEWABLE ENERGY
11	FRAUNHOFER	FRAUNHOFER ICT

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