“Device with a Bio-Interdigitated Flow-Field Structure for Use in Electrochemical Energy Storage Cells”

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Technology description

The technology consists of a device characterized by the inclusion of a main plate configured with a central section that has machined on its surface a flow-field structure similar to a four-leaf clover flow-field pattern (“bio-interdigitated”). In this structure, the central section is divided into four mutually symmetric quadrants, enabling higher efficiency in electrolyte distribution.

Applications, benefits and potencial uses of the technology

The technology is applicable to batteries and electrochemical energy storage devices, including but not limited to the following:

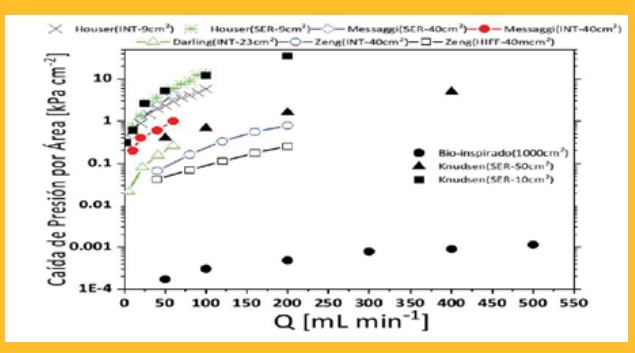
- Redox flow cells.
- Proton exchange membrane (PEM) fuel cells.
- Water electrolysis cells.
- Methanol-based fuel cells.

The technology overcomes disadvantages present in energy storage cells described in the state of the art, where conventional flow fields exhibit limitations such as excessive pressure drop.

The advantages of the technology include:

- Enables operation over a wide range of electrolyte inlet flow rates and electrode active areas.
- Promotes the handling of high electrolyte inlet flow rates in redox flow batteries (RFBs) without a significant increase in pressure drop across the entire cell.
- Improves homogeneous electrolyte distribution within the electrodes, thereby increasing mass transfer in regions where electrochemical reactions predominantly occur.

A comparison is presented between the experimentally obtained pressure-drop data using the bio-interdigitated flow-field structure and data reported for different flow-field designs, considering the same electrode material.



Under different flow conditions, the pressure drops obtained with the bio-interdigitated flow-field structure are lower than those observed with other flow-field structures. For example, at a flow rate of **200 mL/min**, the bio-interdigitated flow field exhibits a pressure drop of **0.0009 kPa/cm²**, which is significantly lower than the **0.25 kPa/cm²** pressure drop obtained with the HIFF flow field, an improved design of the interdigitated (INT) flow field, whose pressure drop is **0.8 kPa/cm²**.

Technology readiness level

The estimated Technology Readiness Level (TRL) is Level 4, corresponding to functional verification in a laboratory environment, where functional performance requirements are established with respect to the current state of the art.

Market information

The global battery energy storage systems market was valued at USD 41,969.44 million in 2024 and is projected to reach USD 143,229.39 million by 2031, with an expected compound annual growth rate (CAGR) of 17.90% during the 2025–2031 period.

In Mexico, the market was valued at USD 402.79 million in 2024 and is projected to reach USD 922.31 million by 2031, with an expected CAGR of 6.7% between 2025 and 2031. In 2024, the Mexican government presented the National Electric Sector Strategy 2024–2038, which estimates that by 2028, battery-based energy storage capacity will represent 17.9% at the national level.