TECH OFFER

Low-Cost, Intrinsically Safe, and Eco-Friendly Polysulfide Redox Flow Battery

KEY INFORMATION

TECHNOLOGY CATEGORY:
Energy - Battery & SuperCapacitor
Sustainability - Low Carbon Economy
Chemicals - Polymers

TECHNOLOGY READINESS LEVEL (TRL): TRL7
COUNTRY: HONG KONG
ID NUMBER: TO175237

OVERVIEW

To achieve carbon neutrality, the global expansion of renewable power is essential, but its intermittent nature makes long-duration energy storage (LDES) crucial for stabilizing power generation. Current solutions, such as Li-ion batteries, face significant challenges including safety risks, resource scarcity, and recycling issues, highlighting the need for safer, reliable, and eco-friendly alternatives.

Sulphur flow batteries offer a promising solution by using low-cost, earth-abundant materials and storing energy in non-flammable, water-based electrolytes. The battery cost is estimated to be 1/2 of Li-ion and 1/4 of vanadium flow batteries. However, traditional designs suffered from short lifespans and low energy efficiency due to polysulfide crossover and slow reaction kinetics, limiting their commercial viability.

The technology owner has developed a breakthrough solution to addresses these challenges. This intrinsically safe, cost-

effective, and eco-friendly battery features a proprietary membrane, 20 times cheaper and more selective than commercial Nafion, eliminating polysulfide crossover and improving energy efficiency. Advanced catalysts further enhance reaction rates, resulting in a projected lifespan of over 15 years - double that of Li-ion batteries. Successful pilot production using large-scale roll-to-roll manufacturing has led to the world's first commercial sulphur flow battery with an industrial-grade lifespan. The system charges during off-peak hours and discharges during peak demand, reducing electricity costs by up to 70%.

The technology owner is seeking partners to integrate this battery into industrial test-bed sites, including renewable power generation, EV charging stations, and data centres. They are also interested in co-developing energy storage ecosystems in Singapore and establishing supply chain partnerships.

TECHNOLOGY FEATURES & SPECIFICATIONS

The technology is based on two key innovations:

1. **Proprietary Non-Fluorinated Ion-Selective Membrane:** Eliminates polysulfide crossover, extending the battery life to over 10,000 cycles. It utilises a large-scale, low-cost fabrication process, reducing costs to less than 1/20 of commercially available alternatives
2. **Revolutionary Active Organic Molecular Catalyst:** Boosts the reaction rate through homogeneous catalysis, improving the battery efficiency by more than 20% and capacity utilisation over 50%

Key Features and Specifications:

- Industrial Applications: The system is integrated into modular 20-ft containers for scalability. Each system includes one power module and 1-3 energy modules. Each power module provides 100 kW of capacity, and each energy module stores 400 kWh. Systems can be interconnected to scale up to 10 MW for larger applications
- Residential Applications: The system is integrated into cabinets for easy installation. Each power module provides 5 kW of capacity, while each energy module stores 20 kWh of energy
- Durability: Designed with an IP54 protection level, it is highly durable for outdoor applications, especially in Singapore's hot and humid climate

POTENTIAL APPLICATIONS

This battery is capable for most energy storage system (ESS) applications. Potential use cases included, but are not limited to:

- **Generation-Side Energy Storage:** Provides a solution to store energy from renewable sources, including renewable energy integration
- **Grid-Side Energy Storage: R**eplaces the diesel genset and ensures grid stability and reliability through peak shaving and load shifting
- **User-Side Energy Storage:** Includes electric vehicle (EV) charging station, industrial and commercial applications, residential applications, and long-duration backup power for critical infrastructure such as telecom towers and data centres

UNIQUE VALUE PROPOSITION

- **Ultra-Safe: U**tilises non-flammable aqueous electrolytes for inherent safety
- **Low Cost:** Made from earth abundant materials, with electrolyte costs only 1/27 that of vanadium flow batteries

- **Eco-Friendly:** Non-toxic active materials and 100% recyclable at end of life
- **Flexible:** Modular design with flexible discharging time, ideal for long-duration applications
- **Durable:** Over 10,000 cycles of lifespan, far exceeding the performance of standard Li-ion batteries