Technology Transfer Office
TTO – IPM Cell

IIT MADRAS
Indian Institute of Technology Madras

Industrial Consultancy & Sponsored Research (IC&SR)

SYSTEM AND METHOD TO MEASURE ELECTROCHEMICAL PROPERTIES OF MEMBRANE UNDER STRAIN

IITM Technology Available for Licensing

Problem Statement

- Properties and performance of protective, decorative coatings and electrochemical barriers may be affected by strain which is caused due to the application process or external, uncontrollable and sometimes unavoidable factors.
- Application of absolute pressure affects the performance of ion exchange membranes,also protective coatings invariably experience weathering on exposure to strain.

Technology Category/ Market

Category – Energy/Infrastructure & Manufacturing/ Chemical
Applications –Electrochemical, Batteries, Clean energy, Test Equipment, Waste water treatment
Industry – Electrochemical, Clean Energy
Market -The global Power Conversion System (PCS) Electrochemical Energy Storage System market size was valued at USD 2110.7 Million in 2022 and will reach USD 9367.73 Million in 2028, with a CAGR of 28.19% during 2022-2028

Key Features / Value Proposition

Technical Perspective:

- Provides a measurement technique that facilitates a means of applying strain, eliminating the need for exclusive arrangement for applying strain on a membrane, concurrently studying electrochemical properties
- Provides the ability to observe dynamics of ion percolation leading to steady state flux under strain, Straining of membrane using two fluids offers precise control of strain on membrane due to differential pressures

User Perspective:

- Controlled filling techniques, simple, reliable and motion to achieve precise control of loads, quantifiable and controllable strain over membranes.

Research Lab

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Intellectual Property

- **IITM IDF Ref. 1686**
- **IN443343-Granted**

Technology

A system to measure electrochemical properties of a membrane under strain, comprising:

A first container, comprising a first fluid in electric contact with a lead

A second container, comprising a second fluid, a reference electrode, a counter electrode, the second container attached with a membrane at a bottom thereof and forming **a leak tight housing, and placed inside the first container** so as to submerge in the first fluid

A movement mechanism configured to move the second container in a controlled way to control create a predetermined **differential fluid pressure on the membrane** and apply a **predetermined strain to the membrane**;

An electronic control unit configured to control the movement mechanism **and an apparent weight of the second container**

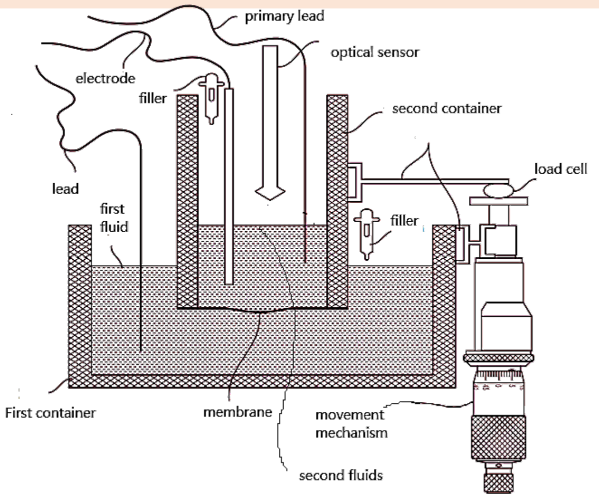

FIG. 1 illustrates a system for measuring electrochemical properties of a membrane

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- The invention further discloses method of **measuring the electrochemical properties of a membrane under strain**
- Applying a predetermined strain to the membrane comprises one or more of: **moving the second container with reference to the first, adjusting height of fluid in the first container, or adjusting height of fluid in the second container**
- The **first and second fluids** are selected from a group consisting of **gallium, mercury, tin, indium or their alloys and applying a predetermined AC or DC** voltage cycle between the first fluid and the reference electrode. of the membrane.
- The fluids are maintained at a temperature range of **25°C to 190°C** for measuring the electrochemical properties

Images

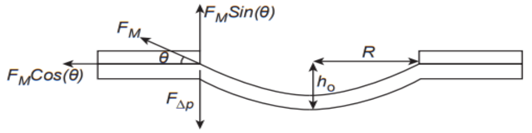

FIG. 2 illustrates the forces acting on a membrane under uniform differential pressure

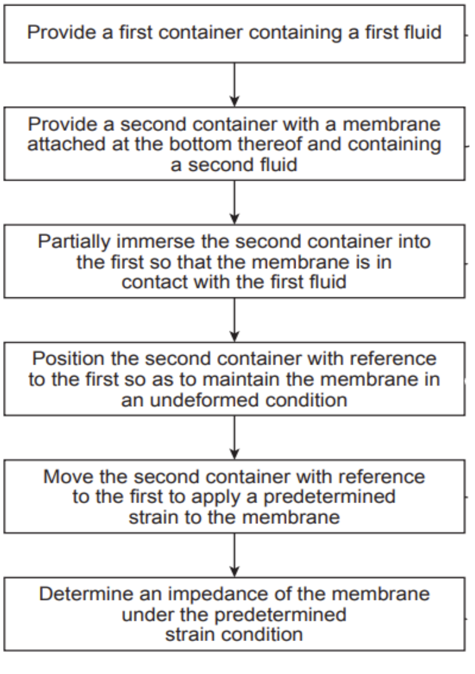

FIG. 3 illustrates a method of measuring electrochemical properties of a membrane.

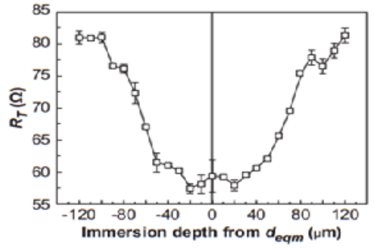

FIG. 4A illustrates change in total resistance RT of a proton conducting polymer membrane with immersion depth.

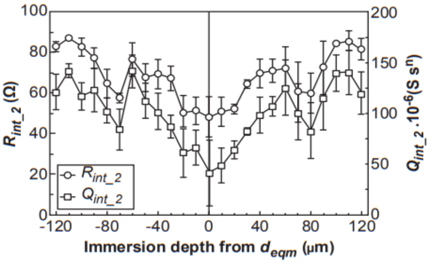

FIG. 4B illustrates the change in first interfacial resistance and capacitance of a proton conducting polymer membrane with immersion depth

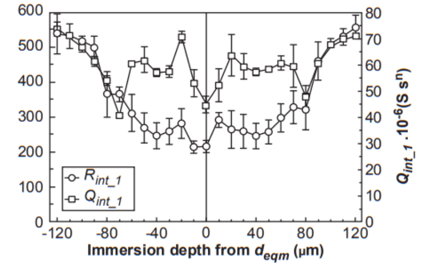

FIG. 4C illustrates the change in second interfacial resistance and capacitance of a proton conducting polymer membrane with immersion depth

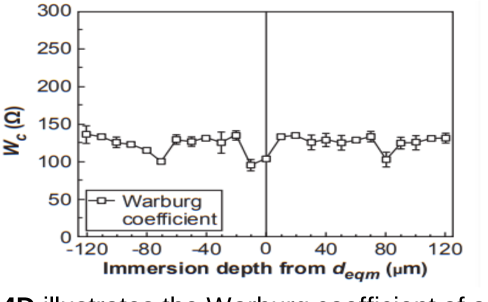

FIG. 4D illustrates the Warburg coefficient of a proton conducting polymer versus immersion depth

TRL (Technology Readiness Level)

TRL-3,Experimental Proof of Concept

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