AN INTEGRATED CDI ELECTRODE
IITM Technology Available for Licensing

Problem Statement

- In the present era, the availability of clean potable water at affordable cost is a growing challenge for mankind. To meet the growing demand of drinking water, many materials & methods are used, but having difficulties due to **expensive** process/implementation, & **consumption of high energy**.
- There are many conventional methods discussed herein does not provide solutions as discussed in the present invention. Hence, there is a need to address above issues.

Technology Category/ Market

Technology: Integrated CDI Electrode;
Industry: Chemical Industry, Grey Water Management Industries; **Application:** Environment Engineering, Waste water treatment;
Market: The global **capacitive deionization** market is projected at a **CAGR** of **5.4%** during (2023-**2026**)

Technology

- Present invention describes the preparation of **an electrode assembly** for **capacitive deionization (CDI)** comprising:
- **One electrode** made of chemically-linked reduced graphene **oxide-cation** exchange resins molecular constructs synthesized by in-situ polymerization of styrene & **reduced graphene oxide (RGO)** followed by functionalization of reduced graphene oxide@polystyrene(**RGO-PS**) composite with sulfonate and/or carboxylate moiety.
- **One electrode** made of chemically-linked reduced graphene **oxide-anion** exchange resins molecular constructs synthesized by in-situ polymerization of styrene & **reduced graphene oxide (RGO)** followed by functionalization of reduced graphene oxide@polystyrene(**RGO-PS**) composite with amine moiety.
- The electro-desorption during CDI does not lead to readsorption & consequent reduction of adsorption capacity of the overall system.
- The covalent construct is mixed with additives includes carbon nanotubes (CNTs), fullerenes and carbon fibers to enhance the performance.
- The electrodes are used for removing salts from blackish water.
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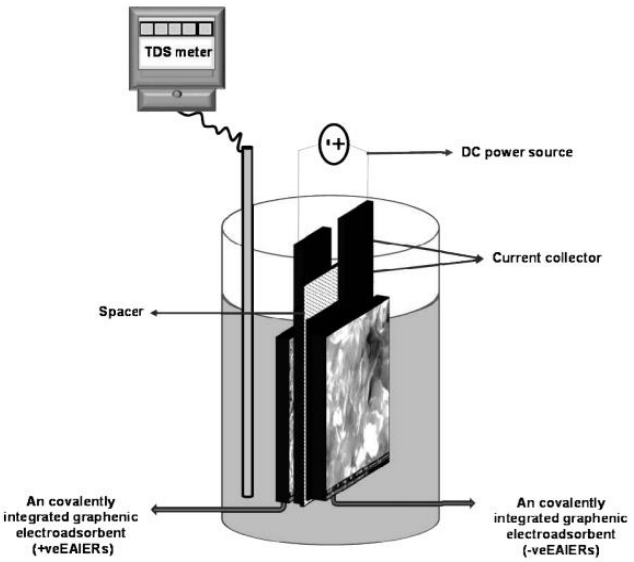

Fig. 1 Illustrates representation of a CDI set-up used for measuring CDI performance.

Intellectual Property

IITM IDF Ref. 1637; Patent No:345270;
PCT Application No. PCT/IN2018/050894
US Application No. US 16/958,971

TRL (Technology Readiness Level)

TRL-4, Proof of concept tested in Lab;

Research Lab

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Key Features / Value Proposition

❖ ***Technical Perspective & Industrial Perspective***:

❖ **Types of Resins used:** The resin selected from the group of polystyrene, polysulphone, poly-acrylic acid, polyacrylamide, poly(methylmethacrylate), polymide, polyethylene terephthalate, polyethylene grafted maleic anhydride, polypropylene, poly(vinyl alcohol), poly(vinyl chloride) & polyethylene vinyl acetate & combination thereof.

❖ **Types of Electrode material/ two-dimensional materials used:** The electrode material is selected from the group of reduced graphene oxide, molybdenum disulfide(MoS2), tungsten diselenide(WSe2), tungsten disulfide(WS2) and combination thereof.

❖ **Removing Cations & Anions and positive-negative charges:** The electrodes remove
→ cation of different charge(including Fe3+, Mg2+and Na+),
→anions of different charge (including Cl-,NO3-, F-, $SO4^{2-}$, arsenite & arsenate ions,
→positive & negative charged ions are removed from impure water.

❖ **Efficiency:** The assembly is used along with other deionization & purification methods to enhance removal efficiency.

❖ **Cost-effective,** provides **single solution** & applicable in the **domestic/Industrialist** area.

Image

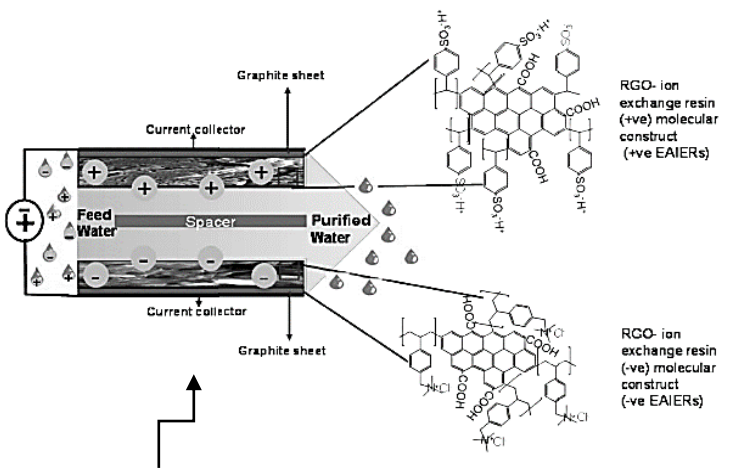

Fig. 2: Illustrates schematic design of a cell with integrated EAIERs (molecular construct) for capacitive deionization (CDI)

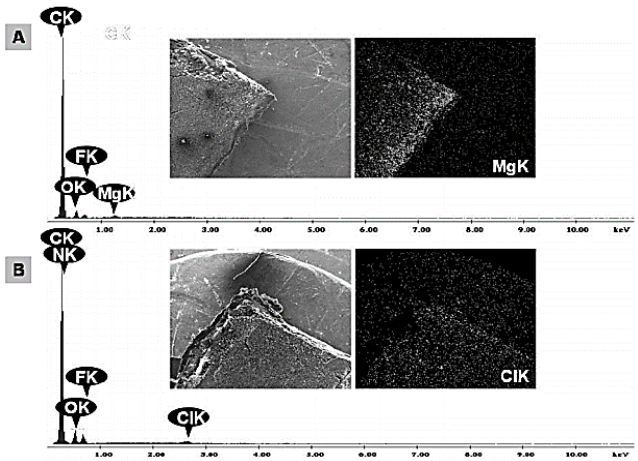

Fig. 3 (above): Illustrates SEM EDS of MgCl2 adsorption after a single adsorption cycle on A) cathode and B)anode, & the corresponding SEM EDS & elemental mapping images shown

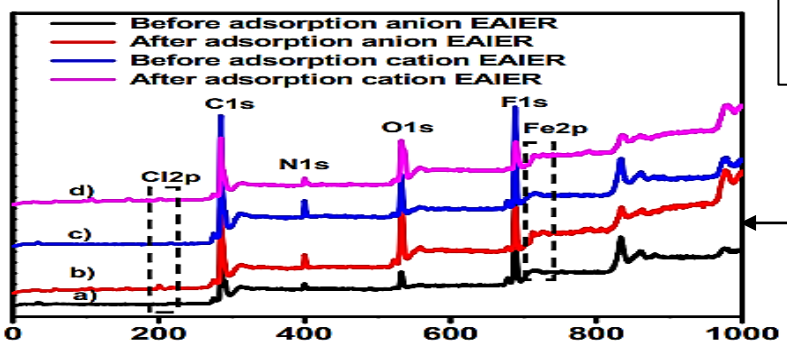

Fig. 4 (Left) : Illustrates XPS survey spectra of the material after single adsorption cycle, (a) anode and (c) cathode (before adsorption);
(b) anode and (d) cathode (after FeCl3 adsorption).

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