ELECTRODE FOR CAPACITIVE DEIONIZATION

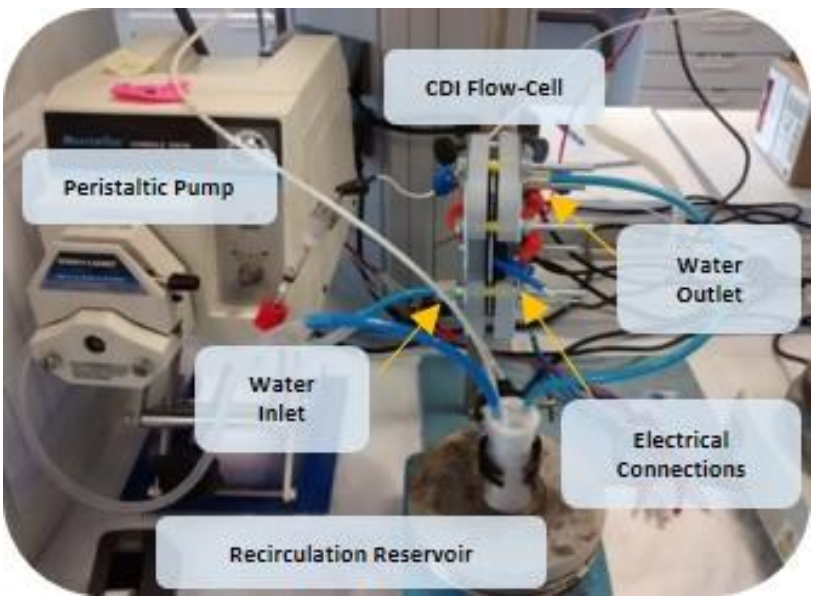
Context

The availability of affordable clean water is one of the key technological, social, and economical challenges of the 21st century. As a consequence, there is a large interest in the development of desalination technologies. Capacitive Deionization (CDI) has emerged over the years as a robust, energy efficient, and cost effective technology for desalination of drinking water. Accordingly. CDI is strongly considered as a versatile technology for desalination able to address the water-energy nexus challenge.

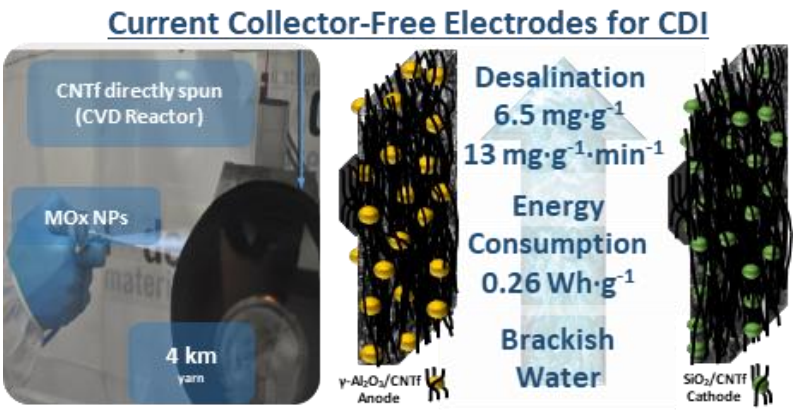
Technology description

Electrode for capacitive deionization in which the active phase and the current collector are included in a single element, i.e. a hybrid material. The fabrication of electrodes is based on the continuous impregnation of CNT fibres with metal oxide precursors in-line as they are spun from the chemical vapour deposition reaction, followed by calcination. Consequently, the electrode of the present invention has a reduced contact resistance and improved charge capacitance which leads to more efficient capacitive deionization systems.

The electrode of the present invention presents a better performance as a result of the synergistic effect between both components of the hybrid material, i.e. the carbon nanotube fibers and the metal oxide coating. The fibers of carbon nanotubes constitute a network that guarantees the properties of electrical conductivity so that they not only act as a current collector but also allow establishing the electrical connection between the coating of metal oxides that is not conductive, but it also has textural and electrochemical properties of interest for capacitive deionization.



Technology advantages



The remarkable efficiency obtained is due to the morphology of the electrodes, in which the CNT fibres act simultaneously as a current collector, active material and support for the metal oxide. Such architecture leads to high capacitance while minimizing internal resistance.

Large salt adsorption capacity of 6.5mgg^{-1} from brackish water (2.0g$_{NaCl}$L^{-1}) and very high efficiency of 86%, which translates into a **low energy consumption per gram of salt removed** (~0.26Whg^{-1}).
This is an 80% improvement compared with reference devices based on activated carbon electrodes and titanium foil current collectors.

Simple fabrication process that enables fabrication of large electrode samples.

The **high conductivity** and **flexibility in bending** of the CNT fibre fabrics opens the possibility to make current collector-free electrodes with complex non-planar shapes.

Supplementary data

Application: Capacitive deionization (water desalination technology)

Intellectual property rights: P201730828 Patent application in Spain. Priority date 22/06/2017

Transfer Opportunity: License of technology

Reference: "*Interconnected metal oxide CNT fibre hybrid networks for current collector-free asymmetric capacitive deionization*" C. Santos, J. J. Lado, E. García-Quismondo, I. V. Rodríguez, D. Hospital-Benito, J. Palma, M. A. Anderson and Juan J. Vilatela. **Journal of Materials Chemistry A**, 2018, 6, 10898-10908. DOI: 10.1039/c8ta01128a

Contact

Knowledge & Technology Transfer Department, IMDEA Materials Institute
techtransfer.materials@imdea.org
0034 91 5493422