Conductive Thin-Films For Direct Membrane Surface Electroheating

Tech ID: 32775 / UC Case 2016-434-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,654,001	05/19/2020	2016-434

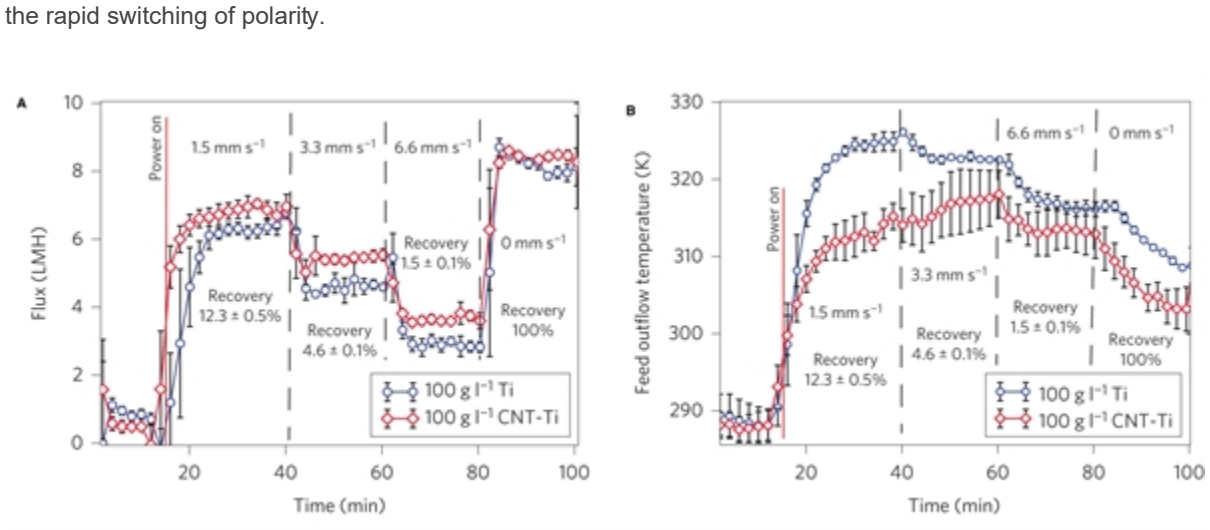
FULL DESCRIPTION

Background

Membrane Distillation (MD) is the treatment method of choice for desalination due to their relative insensitivity to salinity. Hot high-salinity brines are highly corrosive, which makes heat management in these systems, expensive due to the need for corrosion resistant metals. A porous and electrically conducting Carbon Nanotube (CNT) film deposited on the membrane surface, in direct contact with the brine, could be used as a Joule heater to drive the MD desalination process. Although, CNT based Joule heaters have been demonstrated they have either been (a) used in non-ionizable medium or (b) direct current was used to provide the energy. Large electric potentials needed can lead to rapid electrochemical degradation of the CNT films in an ionizable medium due to the formation of electrical double layer (EDL).

Current Invention

Researchers at UCR, led by Prof. David Jassby, have developed a patented technology, a porous, thin film, CNT Joule heater that demonstrate stable operation in highly ionizable environment. The CNT film is made by a layer-by-layer spray coating of carboxylated CNTs and polyvinyl alchohol (PVA) onto a polyvinyl tetrafluoroethylene (PTFE) membranes. The result is a highly conductive, hydrophilic, porous thin film deposited on a hydrophobic porous membrane support. The use of Alternating Current in their development allows for control of the EDL due to the rapid switching of polarity.



Permeate flux and feed outflow temperature data for different cross-flow velocities with a brine concentration of 100 g l–1 NaCl.

ADVANTAGES

The novel aspects of their invention are:

- The spray coating process prevents the CNTs from entering the support membranes pore structure thereby preserving the membrane's separation properties - porosity, hydrophobicity and pore size.

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OTHER INFORMATION

KEYWORDS

Membrane distillation, Water treatment, Pervaporation, Gas separation, Brine extraction, Desalination

CATEGORIZED AS

- **Materials & Chemicals**
  - Composites
  - Thin Films

RELATED CASES

2016-434-0

- Crosslinking of the CNTs with the PVA forms a hydrophilic and robust conductive thin film.
- The distinct dual layer structure of these hydrophilic-hydrophobic membranes allows the vapor formation at the PTFE/CNT interface achieving salt rejection in excess of 99%.
- The use of high frequency alternating current (AC) eliminates the formation of the EDL and therefore the CNT degrading electrochemical reactions are eliminated.

SUGGESTED USES

- Water treatment
- Membrane distillation
- Pervaporation
- Gas separation
- Brine extraction
- Desalination

RELATED MATERIALS

- Frequency-dependent stability of CNT Joule heaters in ionizable media and desalination processes

INVENTIONS BY PROF. DAVID JASSBY

Please see all inventions by Prof. David Jassby and his team at UCR

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