Connecticut Center for Applied Separations Technologies

CAST
CONNECTICUT CENTER FOR
APPLIED SEPARATIONS TECHNOLOGIES

Connecticut
Department of Economic and Community Development

UCONN

Mission Statement

INNOVATION PARTNERSHIP BUILDING
AT THE UCONN TECH PARK

To provide contract R&D services that identify energy and cost-efficient solutions for separations needs through thoughtful consideration of innovative materials, differentiating techniques & robust process design

UCONN RESEARCH

About the Executive Director

INNOVATION PARTNERSHIP BUILDING
AT THE UCONN TECH PARK

Current Positions:

- Al Geib Professor of Environmental Engineering Research & Education, Chemical Engineering Department
- Executive Director, Fraunhofer Center for Energy Innovation

Education

B.S. Chemical Engineering 2002
University of Dayton

Ph.D. Chemical and Environmental Engineering 2008
Yale University

Industrial Experience and Awards

- Global Water Summit Technology Idol Winner
- 3M Nontenured Faculty Award
- Solvay Specialty Polymers Young Faculty Award
- DuPont Young Faculty Award
- Technical Group Leader of a university startup
- Consultant for companies ranging from startups to Fortune 500 companies on membrane technology
- Scientific Advisory Board member for several startups
- Manage rapidly growing contract R&D organization

Scientific Service and Accolades

- President, North American Membrane Society (NAMS)
- Area Chair and Separations Division Director, American Institute of Chemical Engineers
- Gordon Research Conference, co-Chair, 2016
- Boston NAMS meeting, co-Chair, 2015
- EPA Early Career Award
- Fri/John G. Kunesh Award for Separation Science
- Editorial Board of *Journal of Membrane Science* and *Desalination*

Academic Performance

- 80+ refereed articles (>7000 citations)
- 5 issued/pending patents
- 3 book chapters
- 70+ invited seminars and webinars
- 100+ conference presentations
- $6M+ in external funding
- Director of REU Program
- 9 PhD students graduated
- Manage 8 student researchers

DuPont · 3M · United States Environmental Protection Agency · Solvay · Mattershift · AIChE · NAMS North American Membrane Society

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Our Team

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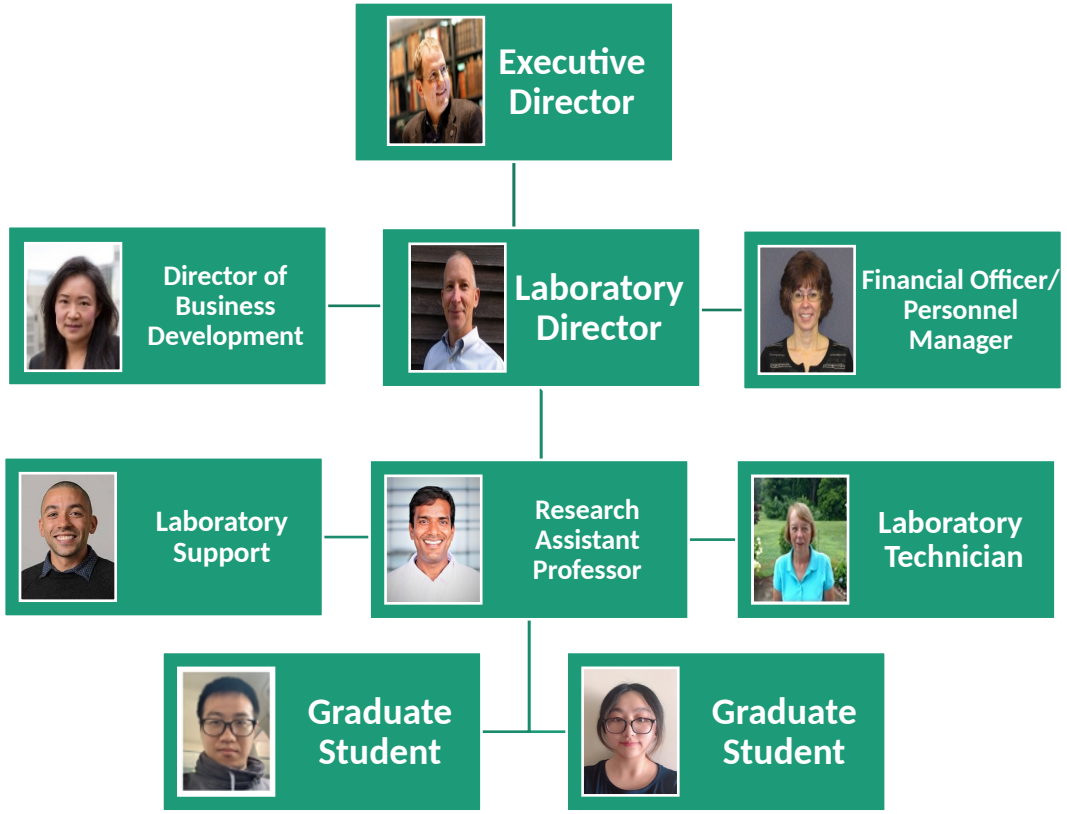

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Develop, Demonstrate & Deploy Separation Technologies across Various Industrial Sectors

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Manufacturing
- Gas separations
- Wastewater
- Energy recovery and storage

Oil & Gas
- Produced waters
- Oil removal
- Brine dewatering
- CO_2 removal

Agriculture
- Biofuels
- Wastewater
- Anaerobic digestion
- Food processing

Food and Beverage
- Dewatering
- Clarification
- Process water

Utilities and Power
- Gas purification
- Energy storage
- Water reuse

Healthcare and Pharmaceuticals
- Drug purification
- Molecular separation / testing
- Wastewater

Technical Separation Capabilities

- Membrane Technology (Organic & Inorganic & Mixed Matrix)
- Membrane Modules and Systems
- Liquid Separations
- Gas Separations / Vapor Permeation
- Particle Separations in Gas/Liquid
- Separations for Energy Efficiency and Production

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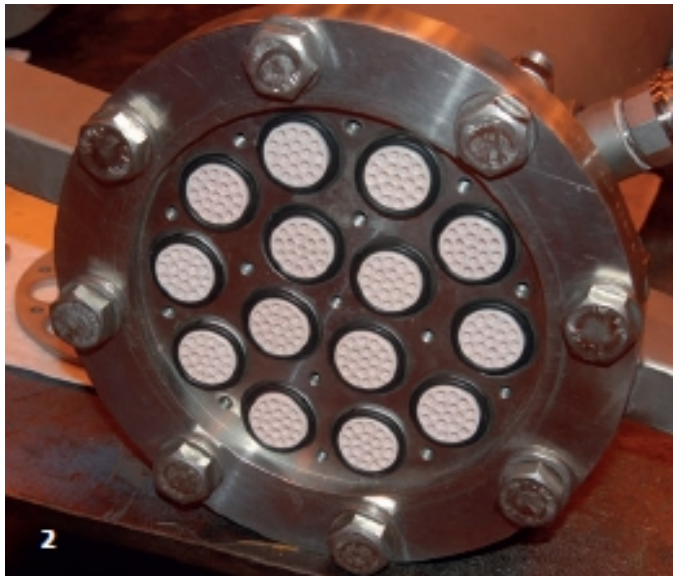
Areas of Technical Focus: Membrane Technology



From the lab to protype to pilot and full-scale, CCAST provides a wide range contract research services for membrane processes related to energy efficient separations across the disciplines of water, solvent, vapor and gas.

Membrane Fabrication Capabilities

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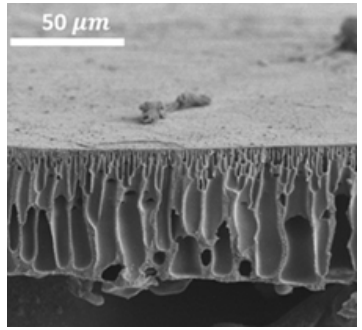
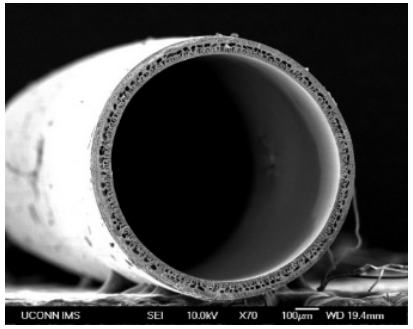
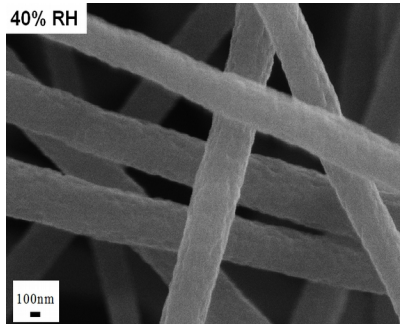
Flat Sheet



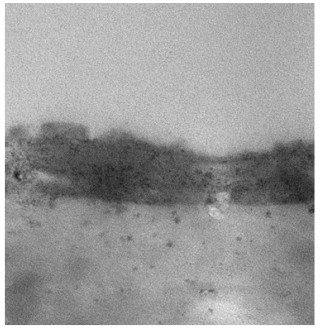
Hollow Fiber



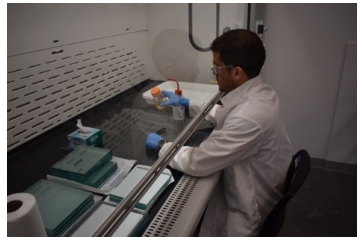
Nanofiber



Printed Thin Film Composite



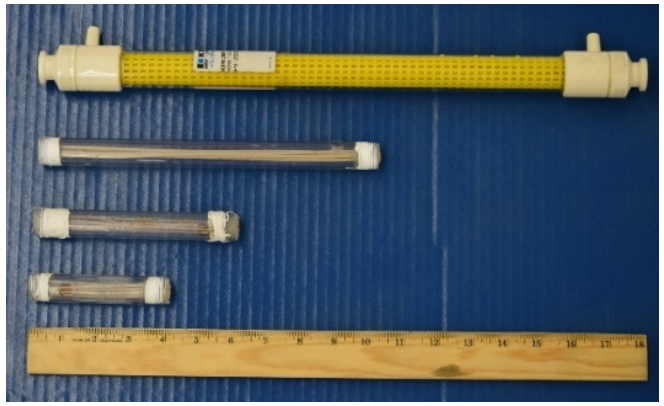
Hand Casting



Fiber Spinning

Electrospinning/Electrospraying

We welcome projects on scale-up and module assembly



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Membrane Testing Capabilities

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Reverse Osmosis Organic solvent nanofiltration Forward osmosis Ultrafiltration

Membrane distillation Vapor permeation Pervaporation Gas permeation

Element-scale testing available for most processes

We welcome membrane and module manufacturers to provide products that we can use for testing services

Separation Testing Design & Fabrication

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In house expertise and experience for the design and fabrication of highly customized test separation units

- ✓ Delivered to customer for their use
- ✓ For in-house testing for customer

Examples of test units

- ❑ High/low pH tolerant units for very acidic/alkaline solutions
- ❑ Specific water removal of water based on customer requirements
- ❑ Specialized ion exchange test cell
- ❑ Membrane test unit to be used on produced wa

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Services Offered by the CCAST

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- Contract research and specialized consulting services
- Solution solving for separations needs across disciplines (water, solvent, vapor, gas)
- Pre-NIOSH mask and material testing for particle filtration
- Membrane characterization, innovation, development, validation and synthesis (performance, longevity) for any separations need
- Lab, prototype, pilot scale testing of membrane process
- Validation of separation technologies with existing or custom-built equipment
- Design and construction of separations prototype / systems
- Comparison/benchmarking of commercial options for tailored separations needs
- Development of standard operating procedures for customized systems and membrane elements
- Analysis of mass transfer processes and membrane separation mechanisms
- Joint development of membrane and systems technology for energy and separations needs
- Scale-up and techno-economic assessment/feasibility studies

- Access to UConn research infrastructure
- Connection to UConn faculty and facilities for more specific expertise

Strategic Partnership on Ceramic Membranes

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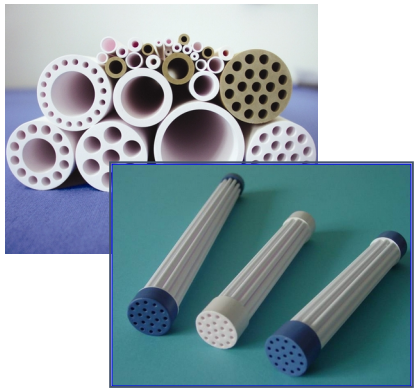
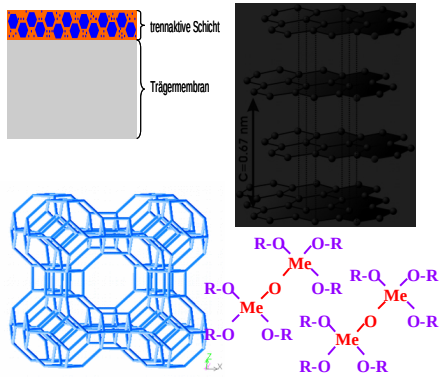
Close partnership with Fraunhofer IKTS in Germany provides access to technical expertise in ceramic membranes

- Development and preparation of support (flat sheet, hollow fiber, monolith)
- Membrane and module design, development and characterization
- Prototyping, piloting, and demonstration
- Simulation and process design



Support Material



Selective Membrane

Testing Piloting

Application

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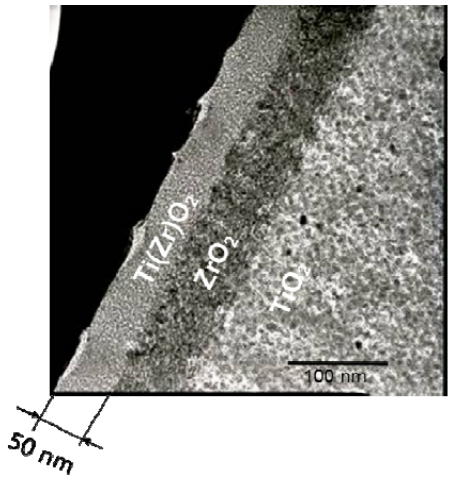
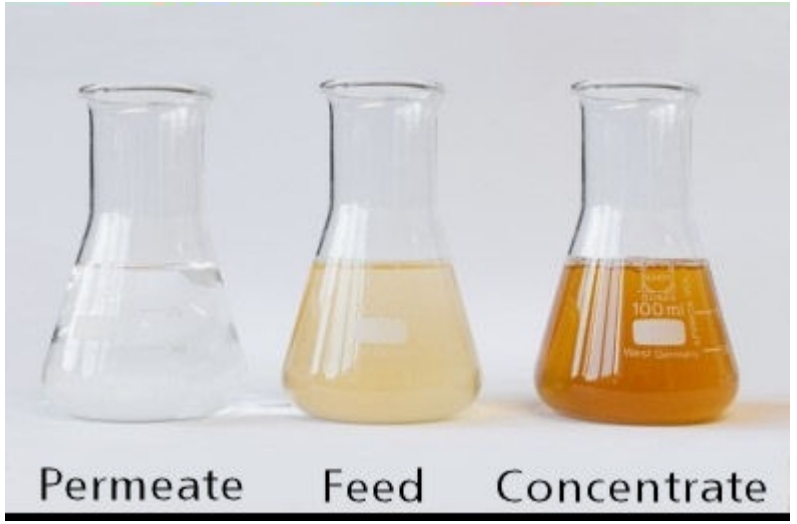
Technical Expertise: Liquid Separations





Technologies

- Ceramic and polymeric membranes
- Pressure driven separation
- Membrane distillation
- Pervaporation
- Forward Osmosis
- Reverse Osmosis
- Others

Applications

- Wastewater concentration
- Color removal or concentration
- Material recovery
- Desalination
- Removal of biological contaminants

Technical Expertise: Gas Separations

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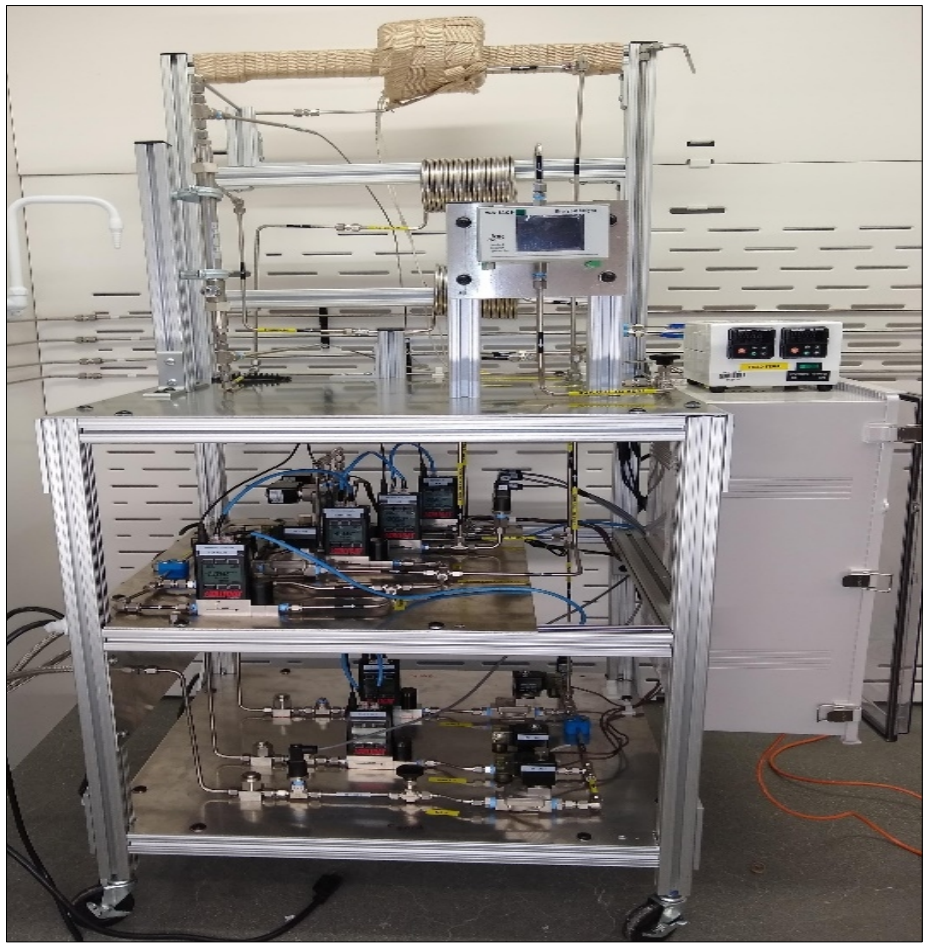

Our test bed enables the testing of numerous membrane (polymeric & inorganic) platforms

- Flat sheet
- Hollow fiber
- Tubular

Applications

- Hydrogen purification and recovery,
- Natural and biogas sweetening,
- Gas dewatering
- Carbon dioxide capture
- Separations of olefins and paraffins

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COVID-19 Response Activities

Inquiries can be directed to Jeffrey McCutcheon

Email: jeffrey.mccutcheon@uconn.edu

Prototyping Rapidly Deployable Ventilators

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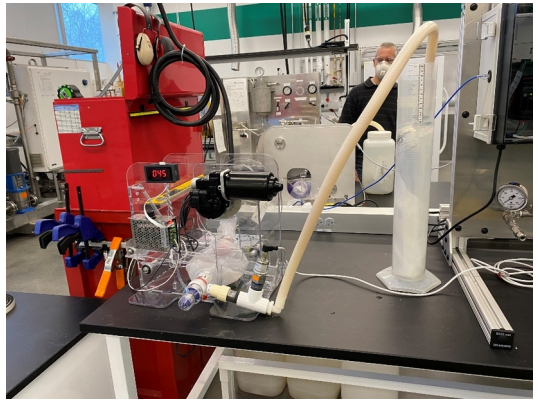
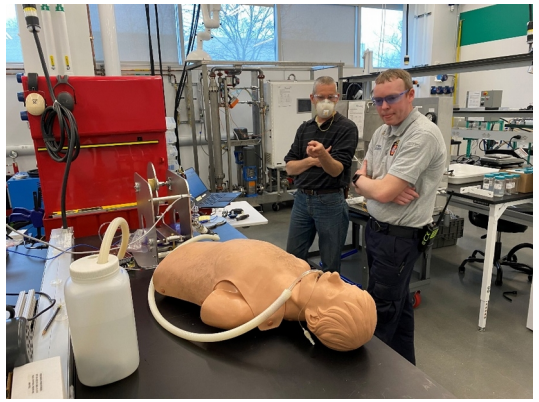
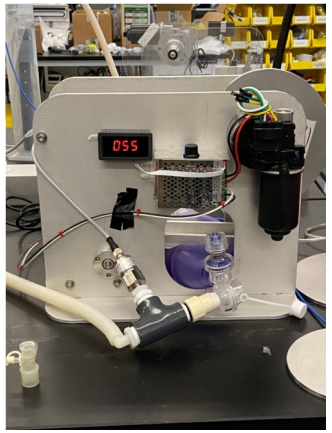
Generation 1 Ventilator



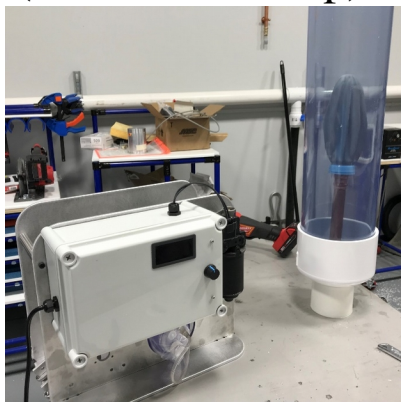


Working with UConn Fire Department

Generation 2 Ventilator



Generation 3 Ventilator (Whitcraft Group)



See our YouTube Video HERE

Recent Activities

- We have developed a basic ambu bag compression system that can provide basic ventilation
- The system is simple, easy to assemble, and could be fabricated and deployed by the dozens in a matter of days
- These would be manufactured and distributed to hospitals as a last-resort option if not enough ventilators were available
- We are prototyping the device to debug and derisk it for manufacturing and use

Team

- Ed Wazer, Lab Director, Project Lead
- Dr. Mayur Ostwal, Res. Asst. Prof.
- Mark Drobney, Biotech Services, UConn
- Steve Ruggiero, COO Whitcraft Group
- Allen Roy, Moonshine Program, Whitcraft Group
- Ali Gokirmak, UConn Department of ECE
- Team of ECE students: Kevin Knowles, Birttany Smith, Colt Nichols, Alexander Jatsiv, Zachary Murtishi
- Michael Baldwin, UCHC

Next Steps

- Continuous improvement on design
- Explore Emergency Use Authorization from the FDA

Special Thanks to

- Colin Cooper, Chief Manufacturing Officer, State of Connecticut
- The Whitcraft Group
- University Communications

Project Contact: Ed Wazer at edward.wazer@uconn.edu

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PPE Performance Verification

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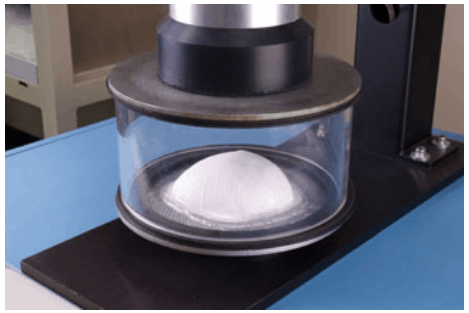

Recent Activities

- We will install NIOSH certified testing methods for facemasks and respirators
- A powerful research tool for other air filtration media
- Verification of mask and respirator performance
- Determination of performance degradation after sterilization and reutilization

Team

- Dr. Mayur Ostwal, Research Asst. Professor, Project Lead
- Ed Wazer, Lab Director

Next Steps

- System shipping early June
- Coordinate delivery of PPE for testing

Special Thanks To

- School of Engineering
- UConn OVPR
- Fraunhofer USA

Project Contact: Mayur Ostwal at mayur.ostwal@uconn.edu

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Hand Sanitizer for Vulnerable Populations

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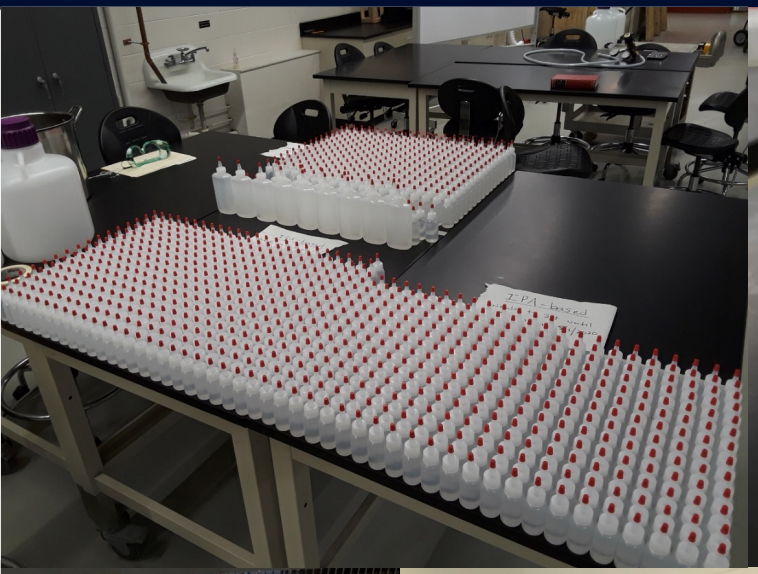

Recent activities

- Donated chemicals from UConn and Connecticut community to be blended with other chemicals using WHO suggested recipes
- Free bottles of sanitizer will be provided to senior living communities, health care providers, first responders, and other communities in need
- 1400 bottles have been produced and distributed to Town of Mansfield, Willimantic Food Pantry, Local Fire Departments

Team

- Noah Ferguson, CBE PhD Student, Project Lead
- Dr. Mayur Ostwal, CBE Res. Asst. Prof.
- Dr. Shan Yong, Director of Bus. Dev., Fraunhofer USA CEI
- Justin Fang, BME PhD student

Next Steps

- Fundraising and donor campaign: WE NEED BOTTLES.
- **Goal of 20,000 bottles**

Special Thanks To

- Timothy Holland, Parker Medical, Bridgewater Connecticut – supply and bottle donor
- Richard Hyman, Future Frogmen, Westport Connecticut – connector and donor “bundler”
- Chris Larosa, SOE, Label Design and Printing
- Amy Allen, UConn Procurement, Label Printing
- Daniel Warren, UConn, label printing

Project Contact: Noah Ferguson at noah.ferguson@uconn.edu

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Sterilization of PPE for Reutilization and HVAC

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Sabre

HYDROZONIX

Technologies (under development)

- Ozonation systems for sterilization
- Chlorine dioxide systems for sterilization
- Ultraviolet light boxes for PPE sterilization

Applications

- Low impact sterilization of masks and respirators
- Room sterilization/fumigation after use for COVID-19 (deep cleaning)

Next Steps

- Apply for funding to evaluate new approaches to sterilization
- Receive test rigs from partners Sabre and Hydrozonix

Project Contact: Shan Yong at shan.yong@uconn.edu

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Other Highlighted Projects

Using Solar Energy to Clean Water

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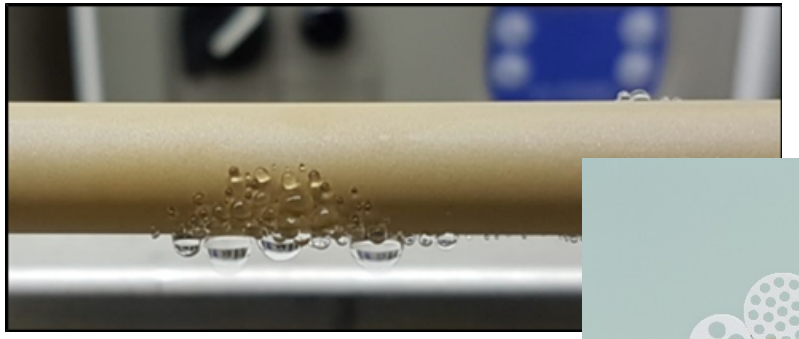
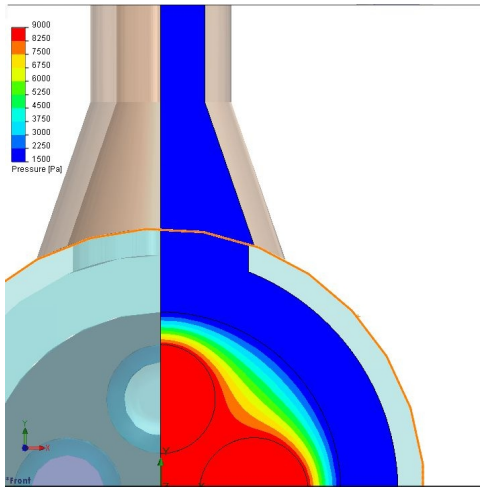
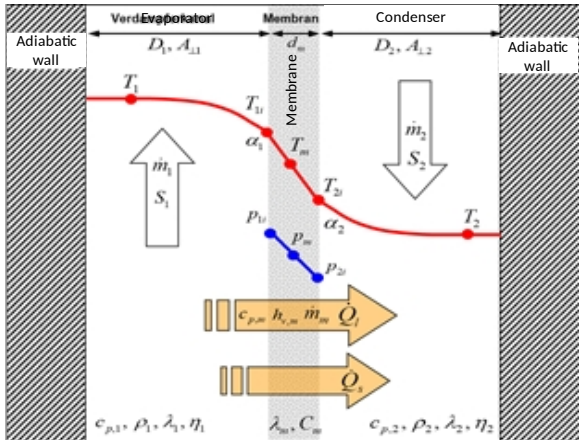
Client: U.S. Department of Energy

- $1.1M Project Funded by the DOE Concentrated Solar Program
- Project performers
  - UConn (Lead)
  - Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)
  - Fraunhofer Institute for Solar Energy Systems (ISE)







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Using Membranes to Help Premature Babies

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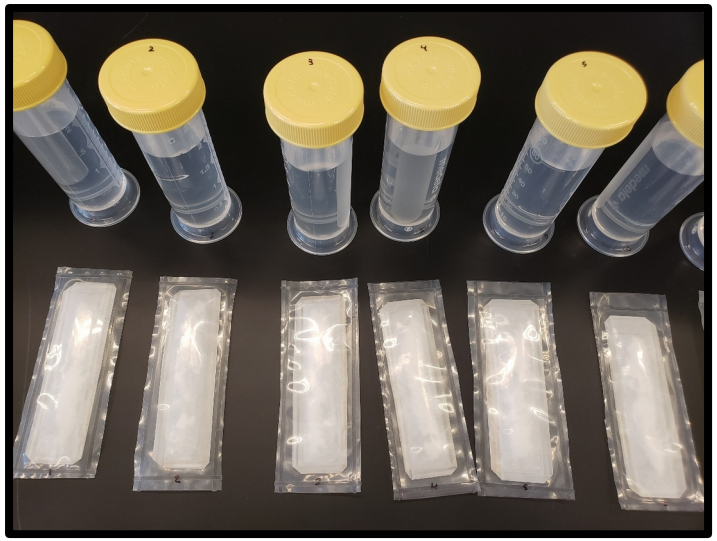
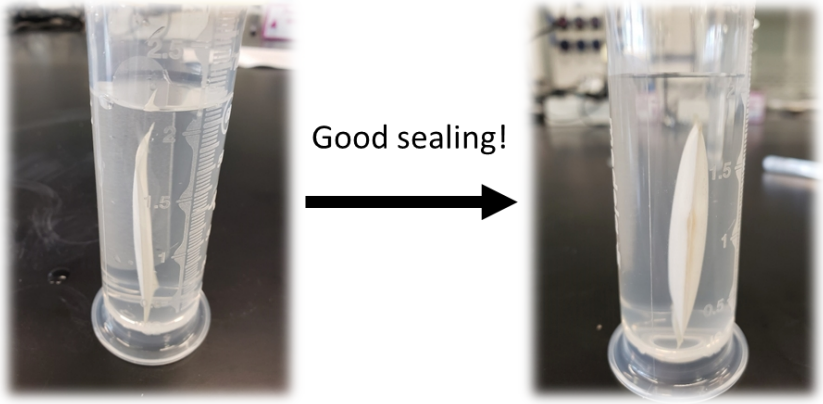
Client: Mother's Milk is Best, Inc.
Location: Boston, MA

We are developing new membrane devices that will gently dewater human breastmilk so that it can be ingested by premature babies.





Capturing Carbon Dioxide to Make Fuel

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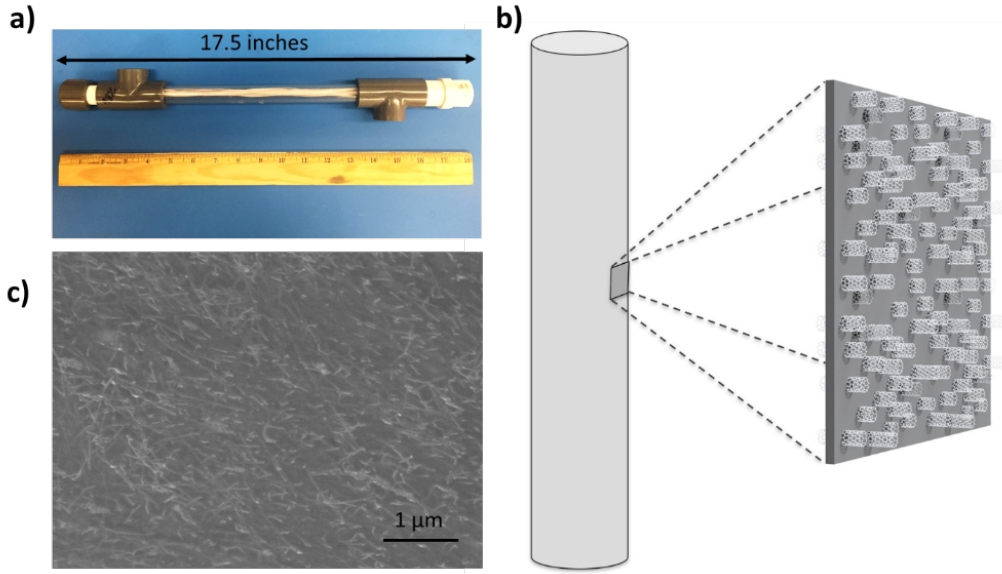
Client: U.S. Department of Energy

- $876k Project on ethanol purification
- Collaboration with two startup companies (Mattershift, Prometheus)
- Recently demonstrated extracting 80% ethanol mixtures from 10% solutions

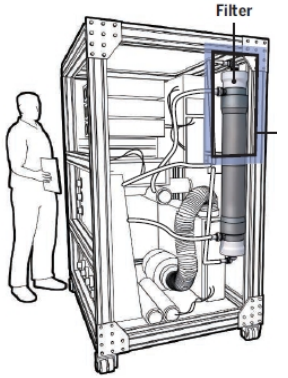


SCIENCE ADVANCES | RESEARCH ARTICLE

MATERIALS SCIENCE

Large-scale polymeric carbon nanotube membranes with sub–1.27-nm pores

Robert L. McGinnis,[1] Kevin Reimund,[1,2] Jian Ren,[2] Lingling Xia,[2] Maqsud R. Chowdhury,[2] Xuanhao Sun,[2] Maritza Abril,[2] Joshua D. Moon,[3] Melanie M. Merrick,[3] Jaesung Park,[3] Kevin A. Stevens,[3] Jeffrey R. McCutcheon,[2] Benny D. Freeman[3]*



NEWS

QUEST FOR FIRE

Rob McGinnis aims to use renewable energy to turn carbon dioxide and water into gasoline

By **Robert F. Service**, in San Francisco, California; Photography by **LiPo Ching**

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Past Industrial Projects

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We serve the pre-revenue startup to the Fortune 100 company

$ 0 **Market Cap of Customers** **$97 B**

- ✓ Fabricated system to test and evaluate the performance of medical devices
- ✓ Evaluated a new water hardness sensor
- ✓ Demonstrated the fouling resistance of a newly developed membrane for desalination
- ✓ Demonstrated the removal of suspended solids from an industrial process
- ✓ Demonstrated using membranes to dewater wastewater
- ✓ Demonstrated using membranes to remove metals from acid wastewater
- ✓ Quantified performance of a new dehumidification concept
- ✓ Evaluated performance of a membrane to recovery a value chemical from a waste stream

Past and Future Events / Outreach

INNOVATION PARTNERSHIP BUILDING
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1. Invite-only Industrial Separations Workshop in Storrs: 85 attendees from 60 separate businesses and entities, September 2019
2. Upstream Oil & Gas Luncheon Roundtable in Houston, December 2019
3. WaterVent 2020 at Storrs CT, which is an international start up & investor matching forum, April 2020 (postponed indefinitely due to COVID-19 outbreak
4. Membrane Innovations Luncheon invite only Roundtable in Boston, with BarClays & Marzarine, April 2020 (postponed due to COVID-19 outbreak
5. Connecticut Sustainability Venture Summit (planned for Fall 2020)
6. 2nd Industrial Workshop on Separations Technology (planned for Fall 2020)
7. Separation Innovations in Healthcare Roundtable Luncheon invite only in Storrs CT Sep 2020

Fraunhofer USA — Fraunhofer USA Center for Energy Innovation

INNOVATION PARTNERSHIP BUILDING AT THE UCONN TECH PARK

Industrial Workshop on Separations Technology

Venue: IPB Building 159 Discovery Drive Storrs-Mansfield CT 06269

8:00 - 8:30 – Breakfast networking

Introductory Session

8:30 – 8:35 – Opening remarks by Jeffrey McCutcheon (Executive Director Fraunhofer USA CEI)
8:35 – 8:40 – Remarks by Nicole Menzenbach (General Consul of Germany to New England)
8:40 – 8:55 – Introduction to Fraunhofer IKTS, Alex Michaelis (Fraunhofer IKTS)
8:55 – 9:10 – Introduction to Fraunhofer USA CEI, Jeffrey McCutcheon (Fraunhofer USA CEI)

Technology Users Session (Session Chair - Jeff McCutcheon)

9:10 – 9:30 – Industry Lecture, J.R. Johnson (ExxonMobil)
9:30 – 9:50 – Industry Lecture, Max Christie (Praxair)
9:50 – 10:10 – Industry Lecture, Harry Cordatos (United Technologies Research Corporation)
10:10 – 10:30 – Industry Lecture, Jian Ren (AbbVie)

10:30 – 10:45 – Coffee Break

Innovation Session (Session Chair – Peter Fiske)

10:45 – 11:35 – Technology Innovation Panel: Startups in the Separations Space, Moderated by Earl Jones, Co-Founder and former Chairman of NorthEast Water Innovation Network
Participants: Via Separations, Anfiro, AquaMembrane, Aquaporin, Membrion, ZwitterCo
11:35 – 11:55 – Featured Startup: Elizabeth Nelson (Mother's Milk is Best, Inc.)
11:55 – 12:15 – Innovation Accelerators: Ian Piro (Isle Utilities)

12:15 – 1:00 – Lunch

1:00 – 1:05 Remarks by Thomas Katsouleas (President of the University of Connecticut)
1:05 – 1:10 – Remarks by Kazem Kazerounian (Dean, University of Connecticut School of Engineering

Water Session (Session Chair: Steve Kloos)

1:10 – 1:30 – Industry Lecture, John Korpiel (Veolia Water Technologies & Solutions)
1:30 – 1:50 – Industry Lecture, Frank Brigano (Marmon Water)
1:50 – 2:10 – Industry Lecture, Rick Stover (Gradiant)

2:10 – 2:25 – Coffee Break

2:25 – 2:30 – Remarks by Radenka Maric (UConn Vice-President for Research)

Technology Producers Session (Session Chair – Jeff McCutcheon)

2:30 – 2:50 – Industry Lecture, Derek Dehn (3M)
2:50 – 3:10 – Industry Lecture, Manny Singh (Koch Membrane Systems)
3:10 – 3:30 – R&D Lecture, Ingolf Voigt (Fraunhofer IKTS)
3:20 – 4:20 – Ceramic Membrane Opportunities Panel: Existing and Emergent Opportunities for Ceramic Membranes, Moderated by Bruce Bishop (CrossTek)
Participants: Alsys, Cerahelix, Inopor/Rauschert, Safbon, i2m, Nanostone

4:20 - 4:25 – Closing Remarks, Jeffrey McCutcheon (Executive Director of Fraunhofer USA CEI)
4:25 onwards – Elective Tour of Facilities and Networking Reception

Connecticut Department of Economic and Community Development

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Want to learn more?

INNOVATION PARTNERSHIP BUILDING
AT THE UCONN TECH PARK

Ask one of us

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