

# Samantha McBride

Presidential Postdoctoral Research Fellow  
Mechanical and Aerospace Engineering  
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## EDUCATION

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Ph.D.	Mechanical Engineering, Massachusetts Institute of Technology (MIT) Thesis: Interfacial engineering for control of crystallization Advised by Prof. Kripa Varanasi	2020 GPA 4.7/5.0
M.S.	Chemical Engineering, Rensselaer Polytechnic Institute (RPI) Thesis: Effect of shear and interfaces on amyloid fibrillation Advised by Prof. Amir Hirsra	2015 GPA 3.9/4.0
B.S.	Environmental Engineering, University of Nevada, Reno (UNR) Summa Cum Laude Advised by Prof. Edward Kolodziej	2013 GPA: 4.0/4.0

## RESEARCH INTERESTS

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My work integrates interfacial/colloidal science, fluid physics, and soft matter physics across multiple length scales to develop engineered solutions for critical challenges in water, energy, and sustainability. Experiments measuring the responses of phase change to engineered interfaces are coupled with theory to augment understanding of molecular and nano/micro- scale transport and phase change phenomena. Applications include material design for sustainability, recovery of resources and energy from waste streams, water purification, desalination, and other problems within the energy-water nexus.

## AWARDS and HONORS

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2022	Mistletoe Research Fellowship (one of 32 from 430 candidates)
2021	The Water Council Tech Challenge Finalist (anti-fouling technology)
2021	MIT De Florez Award Competition, 2 <sup>nd</sup> place
2020	Rising Stars in Mechanical Engineering (hosted by UC Berkeley)
2020	Princeton Presidential Postdoctoral Research Fellowship
2019	APS/DFD Milton van Dyke Award (for video highlighting research)
2019	ASGSR Orr-Reynolds Distinguished Service Award
2019	Meredith Kamm Memorial Award (Excellence in graduate studies at MIT ME)
2018	MIT Martin Sustainability Fellow
2015	NSF Graduate Research Fellowship
2014	ASGSR Travel Award
2013	Rensselaer Graduate Fellowship (one of 15 from 4000 applicants)
2013	Tau Beta Pi National Fellowship (Deuchler Fellow No. 33)
2013	ASCE Water Research Competition 2nd place (Open Cycle Desalination)
2012	ASCE College of Engineering Outstanding Service Award
2012	NSF EPSCoR Summer Research Grant

## AWARDED FUNDING

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2022	Momental Foundation Mistletoe Research Fellowship, author Award Value: \$10,000 unfettered
2020	Princeton Presidential Postdoctoral Research Fellowship, author Award Value: \$58,000 per year
2018	Martin Sustainability Fellowship, author, advised by Kripa Varanasi Award Value: \$78,000
2018	MIT Sandbox Innovation Fund Program, co-author with James Rowe Award Value: \$3,000
2015	NSF GRFP, Author, advised by Amir Hirta and Kripa Varanasi Award Value: \$138,000 over 3 years
2015	NASA Flight Opportunities, co-author with principal investigator Amir Hirta Award Value: \$79,000

## RESEARCH EXPERIENCE

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2020 – Present	Post-doctoral research fellow, Stone Research Group, Princeton University Influence of nanoengineered topography on phase change in microfluidic flows, particle adhesion to functionalized surfaces, <i>in situ</i> self-assembly of sustainable anti-scaling coatings, microfluidic models for porous media flows and CO <sub>2</sub> capture, and inertial microfluidics for microplastics separation from water
2015 – 2019	Graduate research fellow, Varanasi Group, Massachusetts Institute of Technology Interfacial engineering to control crystal nucleation and growth in order to design anti-fouling materials, assembly of crystalline coffee-rings from evaporating drops, harnessing fluid instabilities for micro-scale patterning
2018	Intern, Ionic Materials, Woburn MA Use of solid-state electrolytes as ion exchange membranes for electrochemical desalination
2013 – 2015	Graduate research fellow, Hirta Research Group, Rensselaer Polytechnic Institute Effect of shearing flows on protein degradation and amyloid formation using a Taylor-Couette device, protein adsorption and degradation at hydrophobic interfaces
Summer 2013	Research assistant, Environmental Chemistry Group, Leuphana Universität, Germany Material analysis for development of sustainable hygroscopic thermal batteries
2011 – 2013	Research assistant, Kolodziej Research Group, University of Nevada Reno Environmental fate and transport of hormones from livestock run-off to surface waters

## TEACHING EXPERIENCE

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Spring 2020	Lecturer, MIT Department of Materials Science and Engineering. Course: 3.044 Materials Processing Prepared and delivered lectures and recitations for undergraduate engineering course applying thermal fluids engineering to materials design and fabrication. Assisted with writing course homework's, managed gradebook, proctored exams, and held office hours.
Fall 2019	Teaching Assistant, MIT Department of Mechanical Engineering Course: 2.005, Thermal Fluids Engineering Led recitation sessions for core undergraduate engineering course covering basics of thermodynamics, fluid mechanics, and heat transfer. Held office hours to assist students with homework problems, maintained gradebook, coordinated graders, assisted in exam grading, and led pre-exam review sessions. Received positive evaluations with an average rating of 6.7/7.

- Summer 2018 Instructor, MIT High School Summer Program  
Course: Microgravity and Space Science  
Designed curriculum translating recent developments in microgravity science to a middle school level by incorporating videos, hands-on activities, and interactive questions. Presented to audience of 100+ students during a two-hour lecture.
- Spring 2018 Participant, MIT Kaufman Teaching Certificate Program  
The KTCP is designed to instruct future faculty in designing and facilitating university courses. Assignments included writing a syllabus, constructing effective problem sets and exams, and researching modern theories on teaching and learning.
- Winter 2016 Seminar Lecturer, Nordakademie University of Applied Sciences, Germany  
Prepared and presented two-day seminar course on the business/economic aspects of environmental science and engineering. Awarded honorarium by the University and received 97% positive feedback from student evaluations.
- Fall 2012 Teaching Assistant, University of Nevada, Reno  
Course: CEE 417, Environmental Quality Analysis  
Assisted in curriculum development and organization of laboratory schedule, managed and prepared experiments, equipment, and chemicals, guided students in nutrient and contaminant analysis experiments.

## PUBLICATIONS

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- 2022 Flores, P., Schauer, R., **McBride S.A.**, Luo, J., Hoehn, C., Doraisingam, S., Widhalm, D., Chadha, J., Selman, L., Mueller, D.W., Floyd, S., Rupert, M., Gorti, S., Reagan, S., Varanasi, K.K., Koch, C., Meir, J.U., Muecklich, F., Moeller, R., Stodieck, L., Countryman, S., Zea, L. Preparation for and Performance of a *Pseudomonas Aeruginosa* Biofilm Experiment on board the International Space Station. *Acta Astronautica*, 2022.
- 2021 **McBride, S.A.**, Girard, H.L., Varanasi, K.K. Crystal Critters: Self-ejection of Crystals from Heated, Superhydrophobic Surfaces. *Science Advances*, 7(18), eabe6960, 2021. **Cover Artwork**. Also featured in *Nature Physics*, Vol 16, Jan 2020, page 4.
- 2020 **McBride, S.A.**, Girard, H.L., Varanasi, K.K. Crystal Critters. *Physical Review Fluids*, 5, 110508, 2020. Part of a special collection for the 2019 Gallery of Fluid Motion prize winners.
- 2020 **McBride, S.A.**, Skye, R., Varanasi, K.K. Differences between Colloidal and Crystalline Evaporative Deposits. *Langmuir*, 36(40), 11732-11741, 2020. Selected for **Cover Artwork**.
- 2020 \*Mavukkandy, M.O., \***McBride, S.A.**, Warsinger, D.M., Dizge, N., Hasan, S.W., Arafat, H.A. Thin film deposition techniques for polymeric membranes – A review. *Journal of Membrane Science*, 610, 118258, 2020. \*Co-first authorship.
- 2018 Zea, L., Nisar, Z., Rubin, P., Cortesão, M., Luo, J., **McBride, S.A.**, Moeller, R., Klaus, D., Müller, D., Varanasi, K.K., Muecklich, F., Stodieck, L. Design of a Spaceflight Biofilm Experiment. *Acta Astronautica*, 149, 294-300, 2018.
- 2018 **McBride, S.A.**, Dash, S., Varanasi, K.K. Evaporative Crystallization in Drops on Superhydrophobic and Liquid Impregnated Surfaces. *Langmuir*, 34(41), 12350-12358, 2018. Selected for **Cover Artwork**, October 2018 issue.
- 2017 Balarj, V.S., Zeng, P.C.H., Sanford, S.P., **McBride, S.A.**, Raghunandan, A., Lopez, J.M., Hirsa, A.H. Surface Shear Viscosity as a Macroscopic Probe of Amyloid Fibril Formation at a Fluid Interface. *Soft Matter*, 13, 1780-1787, 2017.
- 2017 Gulati, S., Raghunandan, A., Rasheed, F., **McBride, S.A.**, Hirsa, A.H. Ring-Sheared Drop (RSD): Microgravity Module for Containerless Flow Studies. *Microgravity Science and Technology*, 29, 81-89, 2017.
- 2016 **McBride, S.A.**, Sanford, S.P., Lopez, J.M., Hirsa, A.H. Shear-Induced Amyloid Fibrillization: the role of Inertia. *Soft Matter*, 12, 3461-3467, 2016.
- 2015 **McBride, S.A.**, Tilger, C.F., Sanford, S.P., Tessier, P.M., Hirsa, A.H. Comparison of Human and Bovine Insulin Amyloidogenesis under Uniform Shear. *Journal of Physical Chemistry B*, 119(33), 10426-10433, 2015.

- 2015 Cole, E.A., **McBride, S.A.**, Kimbrough, K.C., Lee, J., Marchand, E.A., Cwiertny, D.M., Kolodziej, E.P. Rates and Product Identification for Trenbolone Acetate Metabolite Biotransformation under Aerobic Conditions. *Environmental Toxicology and Chemistry*, 34(7), 1472-1484, 2015.

## INVITED PRESENTATIONS and PANELS

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- Sep 2020 Composite effects of phase change & fluid instabilities during evaporation of a saline drop: crystal patterning and self-ejection. Princeton Soft Materials Coffee Hour
- May 2020 Nanoscale phenomena during evaporation of saline drops: Salt patterns & crystal ejection. MIT Nano Explorations seminar series
- Dec 2018 McBride, S.A., Rowe, J., Palrecha, A. Adsorption of Parasite Eggs for Farm-level Wastewater Treatment. Presented at the International Water Management Institute-Tata Partner's Meeting, Anand, India,
- July 2018 Panelist and Moderator for Student Space Researcher Panel, International Space Station Research and Development Conference,
- May 2017 Presented on panel titled "Exciting the Next Generation of Scientists and Engineers through the International Space Station," International Space Development Conference, May 2017.
- April 2016 McBride, S.A., Dash, S., Varanasi, K.K. Evaporative Crystallization in Drops on Water Engineering in Space and on Earth. Presented as part of a panel on capitol hill titled "Scientists Bringing International Space Station Research Down to Earth," April 2016.
- Oct 2015 Meet the Scientists. Panel presentation for high school students, at the American Society for Gravitational and Space Research, Oct 2015.

## CONTRIBUTED PRESENTATIONS

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- Nov 2022 McBride, S.A., Coletto, F.T., Kaneelil, P.R., Knopp, R., Taylor, A.J., Storey-Matsutani, M.A., Wilson, J.L., Stone, H.A. Effect of Capillary Number on Drainage from Microscale Sinusoidal Pores. American Physical Society Division of Fluid Dynamics 74<sup>th</sup> Annual Meeting. *Submitted*
- Aug 2022 McBride, S.A., Christie, K., Stone, H. Unrefined Coconut Oil for Hydrophobic Anti-scaling Coatings. American Chemical Society Fall Meeting 2022
- Aug 2022 McBride, S.A., Lake, J.R., Varanasi, K.K. Effect of Water Composition on Self-ejection of Salt Crystals from Hydrophobic and Superhydrophobic Surfaces. American Chemical Society Fall Meeting 2022
- Nov 2019 McBride, S.A., Girard, H.L., Varanasi, K.K. Crystal Critters: growth and ejection of crystals from heated, superhydrophobic surfaces. American Physical Society Division of Fluid Dynamics 72<sup>nd</sup> Annual Meeting. Selected for interview with APS Media
- June 2019 McBride, S.A., Atis, S., Dash, S., Varanasi, K.K. Crystal patterning via Evaporation: spirals, triangles, rings, and arrays. 93<sup>rd</sup> American Chemical Society Colloid and Surface Science Symposium.
- April 2019 McBride, S.A., Skye, R., Varanasi, K.K. Surface Energy Interactions in Crystalline Coffee Rings. 2019 Materials Research Society Spring Meeting
- Mar 2019 McBride, S.A., Atis, S., Khan, S., Varanasi, K.K. Dewetting Front Instabilities for Micro-patterning. American Physical Society March Meeting
- Dec 2018 Skye, R., McBride, S.A., Varanasi, K.K. The Differences Between Colloidal and Crystalline Evaporative Deposits. Poster, 2018 Materials Research Society Fall meeting
- Nov 2018 McBride, S.A., Munoz-Abujder, R.R.R., Putman, E., Bhaskar, R., Lopez-Camara, C.F., Helmig, J. Space Science Outreach to Initiate Student Interest in STEM. American Society for Gravitational and Space Research 34<sup>th</sup> Annual Meeting
- Aug 2018 McBride, S.A., Dash, S., Khan, S., Varanasi, K.K. Spirals from Drops. 256<sup>th</sup> American Chemical Society National Meeting
- July 2018 A Space Science Curriculum to Initiate Student Interest in STEM. International Space Station Research and Development Conference
- Nov 2017 McBride, S.A., Dash, S., Khan, S., Varanasi, K.K. Crystalline desiccation patterns and film break up from evaporating drops on hydrophobic oxide surfaces. American Physical Society Division of Fluid Dynamics 70<sup>th</sup> Annual Meeting

Oct 2017	McBride, S.A., Varanasi, K.K. Influence of Gravitational Orientation and Convection on Desiccation Patterns. American Society for Gravitational and Space Research 33 <sup>rd</sup> Annual Meeting
Mar 2017	McBride, S.A., Dash, S., Khan, S., Varanasi, K.K. Interfacial Engineering for Suppressing Scale Formation. The Materials Society: Energy Materials 2017
Nov 2016	McBride, S.A., Dash, S., Varanasi, K.K. Crystal Deposition Patterns from Evaporating Sessile Drops on Superhydrophobic and Liquid Impregnated Surfaces. American Physical Society Division of Fluid Dynamics 69 <sup>th</sup> Annual Conference
Nov 2015	McBride, S.A., Sanford, S.P., Lopez, J., Hirs, A. Probing the Biophysics behind Flow-Induced Amyloid Crystallization. American Physical Society Division of Fluid Dynamics 68 <sup>th</sup> Annual Meeting
Oct 2015	McBride, S.A. Water Separations: Challenges Separating Water in Space. American Society for Gravitational and Space Research 31 <sup>st</sup> Annual Meeting
Feb 2015	McBride, S.A., Tilger, C., Sanford, S., Hirs, A. Effect of Hydrophobic Residues on Interfacial Fibrillization Kinetics. Poster, Biophysical Society 59 <sup>th</sup> Annual Meeting
Nov 2014	McBride, S.A., Tilger, C., Hirs, A., Lopez, J. Self-assembly of protein fibrils in stable circular Couette flow. American Physical Society Division of Fluid Dynamics 67 <sup>th</sup> Annual Meeting
Oct 2014	McBride, S.A., Tilger, C., Lopez, J., Hirs, A. Ring Sheared Drop Experiment for the Study of Amyloid Fibrils in Microgravity. 30 <sup>th</sup> American Society for Gravitational and Space Research 30 <sup>th</sup> Annual Meeting
Apr 2013	McBride, S.A. Open-Cycle Desalination. Paper and Presentation compiled for ASCE mid-pacific international Open Water Research competition. Awarded second place.
Apr 2012	McBride, S.A., Kolodziej, E.P. Determination of Sorption Mechanisms for 17 $\beta$ -Trenbolone. Poster. Nevada Water Environment Association Annual Conference

## LEADERSHIP and SERVICE

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2022-2023	Member-at-Large, American Chemical Society Division of Environment Chemistry
2021-2022	Participant, Keller Center Program in Institutional and Historical Racism Selected to participate in program for understanding institutional racism and implementing solutions to target structural barriers at Princeton University. Spearheaded a program, along with two other postdocs, designed to connect postdoctoral scholars to DEI work.
2018-2022	Judge, Stockholm Junior Water Prize (U.S. Nationals) Served on a panel of judges selected for expertise in water research to judge entries to the Stockholm Junior Water Prize. Reviewed written reports from high school students, interviewed participants, and helped select a winner to represent the U.S. at the international competition.
2015-2018	Student President, American Society for Gravitational and Space Research Led a team of 25 other students in a national club dedicated to microgravity research. Organized two science advocacy trips to D.C., presented at a congressional panel and educational panels, organized outreach activities at local schools, science fairs, and conferences; built a website for student group, wrote chapter by-laws, organized fundraising efforts resulting in the largest club budget to date, and organized/emceed conference events
2017-2018	Vice President, MIT Water Club Organized monthly seminar series on topics related to water research, organized and served as panel moderator for MIT's 2017 Water Summit on water/agriculture nexus, volunteered at Water Innovation Prize events, and helped organize the 2018 MIT Water Night for 200+ attendees
2014-2015	Mentor, Troy Sponsor-a-Scholar Program Participated in a program that helps low-income students with strong academic records stay on track, met with student mentee once a week to discuss homework and college plans

- 2011-2013      Team Captain, UNR ASCE Water Treatment Team  
Organized teams of students to compete in the Water Treatment Competition at the Annual Mid-Pacific Regional ASCE Student Conference, developed various water quality protocols to rapidly characterize and modify a sample's pH, conductivity, metal content, and nutrient content. Wrote technical reports for the 2012 and 2013 competitions; Report placed 2nd out of 14 participating schools in 2012 and 3rd of 11 schools in 2013
- 2012-2013      Student Body Secretary, UNR ASCE  
Promoted and arranged 12+ guest speaker events, industrial tours, and student meetings. Wrote the university annual report which resulted in the chapter's first Certificate of Commendation from the national branch, recorded meeting minutes and organized schedules

## PROGRAMS, LANGUAGES, LAB EQUIPMENT

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**Programs:** AutoCAD, MATLAB, Mathematica & Wolfram, Excel, GIMP Image Manipulation

**Languages:** English (native), advanced German

**Microscopy/Imaging:** Optical, confocal, and fluorescence microscopy, atomic force (AFM), scanning electron (SEM), high speed imaging

**Fabrication:** Photolithography, Reactive Ion Etch (RIE), cleanroom protocols, laser cutting, vertical mill and other machining

**Analysis:** Liquid/gas chromatography tandem mass spectroscopy (GCMS, LCMS), gravimetric analysis (TGA), circular dichroism (CD), X-ray Diffraction (XRD), X-ray spectroscopy (XPS), colorimetric spectroscopy for water analysis, Ellipsometry, Fourier-transform infrared spectroscopy (FTIR)

## PROFESSIONAL MEMBERSHIPS

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American Chemical Society (ACS)

- ◊ Division of Colloid and Surface Science
- ◊ Division of Environmental Chemistry

American Institute of Chemical Engineers (AIChE)

American Society for Gravitational and Space Research (ASGSR)

American Physical Society (APS)

- ◊ Division of Fluid Dynamics
- ◊ Topical Group on Soft Matter Physics

Materials Research Society (MRS)

Water Environment Federation (WEF)

## SELECTED PRESS COVERAGE

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- Science Magazine      **Headline:** These strange salt 'creatures' could help unclog power plant pipes  
Article and video by Joel Goldberg, Apr. 28, 2021  
Featured on [Sciencemag.org](http://Sciencemag.org)
- MIT News      **Headline:** How to get salt out of water: Make it self-eject  
Article written by David L. Chandler, video by Melanie Gonick, Apr. 28, 2021  
Featured on [news.mit.edu](http://news.mit.edu)
- Physics Today      **Headline:** Salt crystals remove themselves from hydrophobic surfaces  
Article written by Mark Wilson, May 2021  
Featured on [physicstoday.com](http://physicstoday.com)
- Physics      **Headline:** Video prize dominated by superhydrophobic surfaces  
Feature by David Ehrenstein, Nov. 27, 2019

Physics World      Featured on physics.aps.org and in press: Physics 12, 136  
Headline: "Crystal Critters" self-eject from salty solution  
Headline article by Isabelle Dume, May 13, 2021  
Featured on physicsworld.com

FYFluidDynamics      Headline: Crystalline Critters  
Blog post by Nicole Sharp, Aug. 24, 2020  
Featured on fyfluidynamics.com

EurekAlert!      Headline: How to get salt out of water: Make it self-eject  
Reprint of article from MIT News by David Chandler, Apr. 28, 2021  
Featured on EurekAlert.org