

# Ashwin Kumar RAJAGOPALAN

Lecturer in Chemical Engineering, The University of Manchester

Born on December 23rd, 1991 in Neyveli, Tamil Nadu, INDIA

Citizen of INDIA

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## SUMMARY

Seven years of research experience in the field of chemical process engineering, particularly on gas adsorption and crystallization. Highly skilled in utilizing experimental, modeling, and data analytics techniques for chemical processes. A "Do it yourself" engineer with a drive to design and build experimental setups for academic research. Published 10+ articles in peer-reviewed scientific journals. Three years of teaching experience on core chemical engineering courses.

## EDUCATIONAL QUALIFICATIONS

### Doctor of Sciences of ETH Zurich (Dr. sc. ETH Zurich)

(Oct. 2015 - Jul. 2019)

Thesis Title: "A Dual Projection Imaging System To Characterize Crystallization Processes: Design and Applications"

Advisor: Prof. Dr. Marco Mazzotti

Co-advisor: Prof. Dr. Manfred Morari

Separation Processes Laboratory, Institute of Process Engineering

Department of Mechanical and Process Engineering

ETH Zurich, Zurich, SWITZERLAND

Date of doctoral examination: July 23rd, 2019

### Master of Science (MSc) in Chemical Engineering

(Sept. 2013 - Aug. 2015)

Thesis Title: "Material selection and process design for adsorptive CO<sub>2</sub> capture"

Advisor: Prof. Dr. Arvind Rajendran

Laboratory for Advanced Separation Processes

Department of Chemical and Materials Engineering

University of Alberta, Edmonton, Alberta, CANADA

GPA: 3.60/4.00

### Bachelor of Technology (B. Tech.) in Chemical Engineering

(Aug. 2009 - May 2013)

Department of Chemical Engineering

National Institute of Technology Tiruchirappalli

Tiruchirappalli, Tamil Nadu, INDIA

GPA: 8.76/10.00

## PROFESSIONAL APPOINTMENTS

### Lecturer (Academic & Research)

(Sept. 2021 - )

School of Chemical Engineering and Analytical Science

The University of Manchester, Manchester, UNITED KINGDOM

### SNSF Early Postdoc.Mobility Fellow

(Oct. 2020 - Aug. 2021)

Funding Agency: Swiss National Science Foundation (SNSF)

Advisor: Dr. Camille Petit

Multifunctional Nanomaterials Group

Faculty of Engineering, Department of Chemical Engineering

Imperial College London, London, UNITED KINGDOM

## Postdoctoral Research Associate

(Aug. 2019 - Sept. 2020)

Advisor: Prof. Dr. Marco Mazzotti

Separation Processes Laboratory, Institute of Process Engineering

Department of Mechanical and Process Engineering

ETH Zurich, Zurich, SWITZERLAND

## FELLOWSHIPS & GRANTS

- Swiss National Science Foundation *Early.Postdoc Mobility* fellowship, **2020-2022**. (Secured CHF 84,400)

## AWARDS & RECOGNITION

- EFCE Excellence Award in Crystallization for the best doctoral thesis, European Federation of Chemical Engineering, **2020**.
- S. H. Ibrahim Memorial Award for Best Outgoing Student in Chemical Engineering, National Institute of Technology Tiruchirappalli, **2013**.

## TEACHING EXPERIENCE

### ETH Zurich

- Rate Controlled Separations in Fine Chemistry (151-0927-00L), **2017-2019**. (Class of 30, delivering one or two lectures per semester)
- Separation Process Technology (151-0926-00L), **2017-2019**. (Class of 30, delivering one or two lectures per semester)
- Practica in Process Engineering II (151-0958-00L), **2016-2018**

### University of Alberta

- Mass Transfer (CHE318), **2014**. (Class of 50, delivering seminars during exercise hours)

## MENTORING

### The University of Manchester









- M11. Petros Neoptolemos (PhD student, cosupervised with Dr. Aurora Cruz-Cabeza), The University of Manchester, **2021** (*ongoing*).

### ETH Zurich

- M10. Selin Güngör (MSc), Process Design for Lactose Crystallization, *Research Assistant*, ETH Zurich, **2020**.
- M9. Anna Jaeggi (MSc), How Well Can We Characterize Platelet Dimensions?, *Research Assistant*, ETH Zurich, **2019**.
- M8. Nick McDonald (MSc), Dilution Loop: Enhanced Monitoring of Dense Particle Suspensions using Imaging, *Semester Thesis*, ETH Zurich, **2019**.
- M7. Ayoung Song (BSc), Study on the Solubility, Antisolvent Nucleation and Steady-State Shape of Sodium Acetate, *Research Assistant*, ETH Zurich, **2019**.
- M6. Marta Fochesato (MSc), Technical Assessment of Downstream Processes in Tablet Manufacturing, *Research Assistant*, ETH Zurich, **2019**.
- M5. Bianca Popa (BSc), Study on the Solubility, Anti-Solvent Nucleation and Steady State Shape of Sodium Acetate, *Research Assistant*, ETH Zurich, **2019**.
- M4. Igor Rombaut (MSc), Feedback Control for the Size and Shape Evolution of Needle-like Crystals in Suspension: Multistage Process, *Master Thesis*, ETH Zurich, **2019**.
- M3. Johann Bartenstein (MSc), Study on the Solubility and Nucleation of Acetates, *Semester Thesis*, ETH Zurich, **2018**.
- M2. Ramona Achermann (MSc), Feasibility Study for Measuring *nD* PSSD of Dense Suspensions, *Semester Thesis*, ETH Zurich, **2017**.
- M1. Janik Schneeberger (MSc), 3D Reconstruction and Classification of Crystals for Chemical Process Control, *Master Thesis*, ETH Zurich, **2016**.

## RESEARCH OUTPUT

### Publications in Peer-reviewed Scientific Journals (\* indicates shared authorship, # indicates mentee)

- J15. Azzan, H.\*; **Rajagopalan, A. K.\***; Pini, R.; Petit, C. From Surface Area to Adsorption Kinetics: A Comprehensive Pipeline to Characterize Porous Materials. *In Preparation*
- J14. **Rajagopalan, A. K.**; Petit, C. Material Screening for Gas Sensing using an Electronic Nose: Thermodynamic and Kinetic Considerations. *Submitted for Publication*
- J13. Jaeggi, A.#; **Rajagopalan, A. K.**; Morari, M.; Mazzotti, M. Characterizing Ensembles of Plate-like Particles via Machine Learning. *Ind. Eng. Chem. Res.* **2021**, 60 (1), 473-483. [doi](#) 
- J12. Bötschi, S.\*; **Rajagopalan, A. K.\***; Rombaut, I.#; Morari, M.; Mazzotti, M. From needle-like toward equant particles: A controlled crystal shape engineering pathway. *Comput. Chem. Eng.* **2019**, 131, 106581. [doi](#) 
- J11. Subraveti, S. G.; Pai, K. N.; **Rajagopalan, A. K.**; Wilkins, N. S.; Rajendran, A.; Jayaraman, A.; Alptekin, G. Cycle design and optimization of novel PSA cycles for pre-combustion CO<sub>2</sub> capture. *Appl. Energy* **2019**, 254, 113624. [doi](#)
- J10. Bötschi, S.; **Rajagopalan, A. K.**; Morari, M.; Mazzotti, M. Feedback Control for the Size and Shape Evolution of Needle-like Crystals in Suspension. IV. Modeling and Control of Dissolution. *Cryst. Growth Des.* **2019**, 19 (7), 4029-4043. [doi](#) 
- J9. **Rajagopalan, A. K.**; Bötschi, S.; Morari, M.; Mazzotti, M. Feedback Control for the Size and Shape Evolution of Needle-like Crystals in Suspension. III. Wet Milling. *Cryst. Growth Des.* **2019**, 19 (5), 28452861. [doi](#) 
- J8. Balashankar, V. S.; **Rajagopalan, A. K.**; De Pauw, R.; Avila, A. M.; Rajendran, A. Analysis of a Batch Adsorber Analogue for Rapid Screening of Adsorbents for Postcombustion CO<sub>2</sub> Capture. *Ind. Eng. Chem. Res.* **2019**, 58 (8), 3314-3328. [doi](#)
- J7. **Rajagopalan, A. K.**; Rajendran, A. The effect of nitrogen adsorption on vacuum swing adsorption based post-combustion CO<sub>2</sub> capture. *Int. J. Greenh. Gas Control* **2018**, 78, 437447. [doi](#)
- J6. **Rajagopalan, A. K.**; Bötschi, S.; Morari, M.; Mazzotti, M. Feedback Control for the Size and Shape Evolution of Needle-like Crystals in Suspension. II. Cooling Crystallization Experiments. *Cryst. Growth Des.* **2018**, 18 (10), 6185-6196. [doi](#) 
- J5. Bötschi, S.; **Rajagopalan, A. K.**; Morari, M.; Mazzotti, M. Feedback Control for the Size and Shape Evolution of Needle-like Crystals in Suspension. I. Concepts and Simulation Studies. *Cryst. Growth Des.* **2018**, 18 (8), 4470-4483. [doi](#) 
- J4. Bötschi, S.\*; **Rajagopalan, A. K.\***; Morari, M.; Mazzotti, M. An Alternative Approach to Estimate Solute Concentration: Exploiting the Information Embedded in the Solid Phase. *J. Phys. Chem. Lett.* **2018**, 9 (15), 4210-4214. [doi](#) 
- J3. **Rajagopalan, A. K.\***; Schneeberger, J.\*#; Salvatori, F.; Bötschi, S.; Ochsenbein, D. R.; Oswald, M. R.; Pollefeys, M.; Mazzotti, M. A comprehensive shape analysis pipeline for stereoscopic measurements of particulate populations in suspension. *Powder Technol.* **2017**, 321, 479-493. [doi](#) 
- J2. **Rajagopalan, A. K.**; Avila, A. M.; Rajendran, A. Do adsorbent screening metrics predict process performance? A process optimisation based study for post-combustion capture of CO<sub>2</sub>. *Int. J. Greenh. Gas Control* **2016**, 46, 76-85. [doi](#)
- J1. **Kumar, A.**; Srivastava, D.; Agrawal, M.; Goel, A. Snapshot of PM Loads Evaluated at Major Road and Railway Intersections in an Urban Locality. *Int. J. Environ. Prot.* **2014**, 4 (1), 23-29.

### Contributions to International Conferences (\* indicates presenting author)

#### Oral Presentations

- O19. **Rajagopalan, A. K.** A Dual Projection Imaging System To Characterize Crystallization Processes: Design and Applications. *21st International Symposium on Industrial Crystallization (ISIC-21)*, Potsdam, Germany, Sep. **2021**. **EFCE EXCELLENCE AWARD IN CRYSTALLIZATION TALK**
- O18. Jaeggi, A.\*; **Rajagopalan, A. K.**; Mazzotti, M. Multidimensional Characterization of Platelets in Particulate Suspensions. *21st International Symposium on Industrial Crystallization (ISIC-21)*, Potsdam, Germany, Sep. **2021**.
- O17. Jaeggi, A.\*; **Rajagopalan, A. K.**; Mazzotti, M. Size and Shape Characterization of Plate-like Crystals. *American Institute of Chemical Engineers (AIChE) Annual Meeting*, San Francisco, USA, Nov. **2020**
- O16. Bötschi, S.; **Rajagopalan, A. K.\***; Morari, M.; Mazzotti, M. Controlled Manipulation of the Size and Shape of Needle-like Compounds in a Cyclic Process. *American Institute of Chemical Engineers (AIChE) Annual Meeting*, Orlando, USA, Nov. **2019**.



- O15. **Rajagopalan, A. K.\***; Bötschi, S.; Morari, M.; Mazzotti, M. Controlled Manipulation of Size and Shape of Needle-like Compounds Using Wet-Milling. *12<sup>th</sup> European Congress of Chemical Engineering (ECCE)*, Florence, Italy, Sept. **2019**.
- O14. **Rajagopalan, A. K.**; Bötschi, S.; Morari, M.; Mazzotti, M.\* On the Manipulation of the Size and Shape of Needle-like Crystals. *British Association of Crystal Growth (BACG) 50<sup>th</sup> Annual Conference*, London, UK, Jul. **2019**. **INVITED TALK**
- O13. Balashankar, V. S.\*; De Pauw, R.; **Rajagopalan, A. K.**; Avila, A. M.; Rajendran, A.\* Batch Adsorber based PSA Model for Rapid and Efficient Screening of Adsorbents in Post-Combustion CO<sub>2</sub> Capture. *68th Canadian Chemical Engineering Conference*, Toronto, Canada, Oct. **2018**.
- O12. **Rajagopalan, A. K.\***; Bötschi, S.; Morari, M.; Mazzotti, M. Experimental Implementation of a Model-Free Feedback Controller for the Size and Shape of Needle-like Crystals Growing in Suspension. *American Institute of Chemical Engineers (AIChE) Annual Meeting*, Pittsburgh, USA, Oct. **2018**.
- O11. Bötschi, S.\*; **Rajagopalan, A. K.**; Morari, M.; Mazzotti, M. Two Feedback Control Schemes for the Size and Shape of Needle-like Crystals Growing in Suspension. *American Institute of Chemical Engineers (AIChE) Annual Meeting*, Pittsburgh, USA, Oct. **2018**.
- O10. Bötschi, S.; **Rajagopalan, A. K.**; Morari, M.; Mazzotti, M.\* Size and shape feedback control for growth-dominated batch crystallization processes. *25th International Workshop on Industrial Crystallization (BIWIC)*, Rouen, France, Sept. **2018**.
- O9. Salvatori, F.\*; **Rajagopalan, A. K.**; Bötschi, S.; Schneeberger, J.; Mazzotti, M. Selective manipulation of crystal shape by combined crystallization, milling, and dissolution stages - An approach for robust process design. *Separations Technology IX: New Frontiers in Media, Techniques, and Technologies*, Albufeira, Portugal, Mar. **2017**.
- O8. **Rajagopalan, A. K.**; Avila, A. M.; Rajendran, A.\* The importance of nitrogen co-adsorption on effectiveness of post-combustion CO<sub>2</sub> capture materials: A process optimization study, *American Institute of Chemical Engineers (AIChE) Annual Meeting*, San Francisco, USA, Nov. **2016**.
- O7. **Rajagopalan, A. K.**; Wilkins, N.; Pai, K. N; Subraveti, S. G. ; Rajendran, A.\*; Jayaraman, A.; Alptekin, G. Optimization of a High Temperature PSA Process for Pre-Combustion CO<sub>2</sub> Capture., *American Institute of Chemical Engineers (AIChE) Annual Meeting*, San Francisco, USA, Nov. **2016**.
- O6. **Rajagopalan, A. K.**; De Pauw, R; Avila, A. M.; Rajendran, A.\* Batch adsorber analogs for rapid screening of adsorbents for CO<sub>2</sub> capture. *American Institute of Chemical Engineers (AIChE) Annual Meeting*, San Francisco, USA, Nov. **2016**.
- O5. **Rajagopalan, A. K.**; De Pauw, R.; Avila, A. M.; Rajendran, A.\* Screening Tools for adsorption based post-combustion CO<sub>2</sub> capture. *66th Canadian Chemical Engineering Conference*, Quebec City, Canada, Oct. **2016**.
- O4. **Rajagopalan, A. K.\***; Salvatori, F.; Ochsenbein, D. R.; Mazzotti, M. Toward the mitigation of growth rate dispersion through pretreatment of seed crystals. *30th Meeting of the European Crystallographic Association*, Basel, Switzerland, Aug. **2016**.
- O3. Makhtoumi, P.\*; Hejazi, S. A. H.; **Rajagopalan, A. K.**; Rajendran, A. Zero Length Column Measurements of Ethane in Na-ETS-10. *65th Canadian Chemical Engineering Conference*, Calgary, Canada, Oct. **2015**.
- O2. **Rajagopalan, A. K.\***; Estupinan, L.; Avila, A. M.; Rajendran, A. Process optimization based selection of adsorbents for post-combustion CO<sub>2</sub> capture. *65th Canadian Chemical Engineering Conference*, Calgary, Canada, Oct. **2015**.
- O1. **Rajagopalan, A. K.\***; Estupinan, L.; Avila, A. M.; Rajendran, A. A process optimization approach for adsorbent screening for post-combustion capture of CO<sub>2</sub>. *Faculty of Engineering Graduate Research Symposium, University of Alberta*, Edmonton, Canada, Jun. **2015**.

#### Poster Presentations

- P11. **Rajagopalan, A. K.\***; Bötschi, S.; Salvatori, F.; Binell, P.; Morari, M.; Mazzotti, M. Size and Shape Engineering of Needle-like Particles: Process Development and Process Control. *21st International Symposium on Industrial Crystallization (ISIC-21)*, Potsdam, Germany, Sep. **2021**.
- P10. **Rajagopalan, A. K.**; Petit, P. Designing a Porous Material based Electronic Nose for Gas Sensing. *Federation of European Zeolite Associations (FEZA) Conference*, Virtual, Jul. **2021**
- P9. Binell, P.; Bötschi, S.; **Rajagopalan, A. K.**; Salvatori, F.; Morari, M.; Mazzotti, M. Monitoring Critical Process Parameters to Design and Control a Crystallization Process. *Foundations of Process Analytics and Machine Learning (FOPAM)*, Raleigh, USA, Aug. **2019**.

- P8. **Rajagopalan, A. K.;** Rajendran, A.\* Its the Nitrogen, Stupid - The Importance of N<sub>2</sub> Adsorption on Adsorptive Postcombustion CO<sub>2</sub> Capture. *13th International Conference on the Fundamentals of Adsorption*, Cairns, Australia, May **2019**.
- P7. **Rajagopalan, A. K.\*;** Rajendran, A. Adsorptive Postcombustion CO<sub>2</sub> Capture: Using Process Optimization to Guide Material Development. *Gordon Research Conference on Carbon Capture, Utilization and Storage*, Les Diablerets, Switzerland, May **2019**.
- P6. Balashankar, V. S.\*; De Pauw, R.; **Rajagopalan, A. K.;** Avila, A. M.; Rajendran, A.\* Simplified Model: Post-Combustion Adsorbent Screening. *67th Canadian Chemical Engineering Conference*, Edmonton, Canada, Oct. **2017**.
- P5. **Rajagopalan, A. K.\*;** Schneeberger, J.; Salvatori, F.; Bötschi, S.; Ochsenbein, D. R.; Oswald, M.; Mazzotti, M. 3D reconstruction and shape classification of crystals for measuring multi-dimensional particle size and shape distribution. *20th International Symposium on Industrial Crystallization (ISIC-20)*, Dublin, Ireland, Sep. **2017**.
- P4. **Rajagopalan, A. K.\*;** Bötschi, S.; Ochsenbein, D. R.; Morari, M.; Mazzotti, M. Characterizing and mitigating growth rate dispersion effects. *12th International Workshop of the Crystal Growth of Organic Materials*, Leeds, United Kingdom, Jun. **2016**.
- P3. Avila, A. M.; **Rajagopalan, A. K.\*;** De Pauw, R.; Rajendran, A. Batch analogues and improved metrics for rapid screening of adsorbents for post-combustion CO<sub>2</sub> capture. *12th International Conference on the Fundamentals of Adsorption*, Friedrichshafen, Germany, May **2016**.
- P2. **Rajagopalan, A. K.\*;** Avila, A. M.; Rajendran, A. Process Optimization based screening and design of adsorbent materials for post-combustion CO<sub>2</sub> capture. *12th International Conference on the Fundamentals of Adsorption*, Friedrichshafen, Germany, May **2016**. **AWARDED BEST-POSTER PRIZE**
- P1. Goel, A.; **Ashwin Kumar, R.\*;** Agrawal, M.; Goel, N.; Yadav, N. Assessment of the air quality in Kanpur city 2011: Impact of traffic and construction activities near major intersections. *International Congress for Environment Research*, Surat, India, Dec. **2011**.

#### Softwares with Documented Use

- S2. Simulator of the batch adsorber analogue model proposed in "Analysis of a Batch Adsorber Analogue for Rapid Screening of Adsorbents for Postcombustion CO<sub>2</sub> Capture. *Ind. Eng. Chem. Res.* **2019**, 58 (8), 3314-3328." 
- S1. Maintainer and developer of the *Crystallization Analysis Toolbox* (CAT) developed in the group Prof. Mazzotti at ETH Zurich. CAT is an open-source software used by the crystallization community to solve population balance equations. 

#### PUBLIC PRESENTATIONS

- T2. **Rajagopalan, A. K..** Toward Sustainable Separation Processes: The Role of Process Monitoring, Design, and Control. *Amirkabir University of Technology*, Tehran, Iran (webinar), Feb. 2021.
- T1. **Rajagopalan, A. K..** 888 Days: Carbon capture to crystal growth. *National Institute of Technology Tiruchirappalli*, Trichy, India, Jan. 2016.

#### REVIEWING ACTIVITIES

- Computers and Chemical Engineering (2021 - present), ACS Omega, (2020 - present), Energies (2020 - present), Adsorption (2019 - present), Chemical Engineering Science (2018 - present), Separation Science and Technology (2018 - present)

#### MEMBERSHIPS

- International Adsorption Society (IAS), **2020 - present**
- American Institute of Chemical Engineers (AIChE), **2018 - present**

September, 2021  
Manchester, United Kingdom