University of Birmingham

Fabricio Marques BEng (Hons) AMIChemE

Carbon Dioxide Capture and Utilisation for Composite Materials

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Supervisors:
Dr Regina Santos (/staff/profiles/chemical-engineering/santos-regina.aspx) Dr Neil Rowson (/staff/profiles/chemical-engineering/rowson-neil.aspx) Dr Peter Hammond (http://www.ccmresearch.co.uk/keyPeople.html)

About

Fabricio is Brazilian and graduated from the University of Birmingham at the top of his class with a 1st class BEng (Hons) in Chemical Engineering in 2010, before starting his PhD in October 2010 as a member of the Supercritical Fluids Research Group (/research/activity/chemical-engineering/energy-chemical/supercritical-fluid/index.aspx) .
Fabricio's PhD is sponsored by CCM Research Ltd (http://www.ccmresearch.co.uk/ccs.html) and focuses on Carbon Dioxide Capture and Utilisation (CCU), material development and testing.
Fabricio also works part-time as a Demonstrator and Mentor for undergraduates, a Mentor for postgraduates, a University Student Ambassador and a Website Content Editor.

Interests

Open all sections

Fabricio can use a wide variety of physical and chemical characterisation techniques to study properties of materials. He has excellent IT skills, particularly in the areas of technical design, modelling, simulation and experimental control.

Fabricio is also involved in various tutoring and mentoring activities as a Postgraduate Demonstrator, Student Ambassador and Peer Mentor.

Fabricio has also attended many courses provided by the Graduate School to improve his entrepeneurial skills, business acumen and Consultancy skills, including Talent Pool (http://www.as.bham.ac.uk/ei/programmes/talentpool.shtml) , Leading Academics (http://www.as.bham.ac.uk/ei/programmes/leading_academics_2012.shtml) , Intellectual Property (http://www.rcs.bham.ac.uk/commercial/ent/IntellectualProperty.shtml) , Project Management (https://intranet.birmingham.ac.uk/hr/development/courses/pm-principles.aspx) , Marketing Yourself (http://www.birmingham.ac.uk/oncampus/events/Enterprise-Workshop.aspx) , Product Design (http://www.birmingham.ac.uk/oncampus/lectures/Product-Design-Seminar.aspx) and many technical training courses.

In his spare time, Fabricio likes to network, travel, and is a keen player of badminton and table tennis. He also attends social, sporting and charity events organised by the Birmingham University Chemical Engineering Society (BUCES (/schools/chemical-engineering/undergraduate/chemical-engineering-society.aspx)), which gives him the opportunity to meet people with similar interests and diverse backgrounds.

Project Details

There is growing agreement that the major cause of current climate change is the emission of greenhouse gases like carbon dioxide (CO_2), the majority of which come from burning fossil fuels. Higher levels of CO_2 in the atmosphere trap more heat from the sun, leading to global warming, which can have dire consequences for the Earth's ecosystem.

Fortunately there are many technologies that can capture CO_2. Nevertheless, most of these are very costly, energy-intensive, require large equipment and have many further limitations. As a result, Fabricio is working on a novel process using eco-friendly plant fibres that can capture CO_2, and then be mixed with other components to form strong, lightweight composite materials that lock the CO_2 permanently, thus avoiding the huge costs and logistics associated with storage underground.

The composite can be used in many applications, such as packaging, furniture, automobiles, construction, bone implants, etc. Therefore this new technology is very promising because of its effectiveness, ease of application, low energy consumption, low cost, economic benefits and mitigation of global climate change concerns, thus contributing to a more sustainable future.

Skills

Rigs

- High Temperature & Pressure Reactors (Parr)
- Fluidised & Fixed-Bed columns
- Supercritical Fluid Extraction (Thar & Parr)
- Rapid Expansion of Supercritical Fluid (RESS) for Particle Coating
- Extruders

Spectroscopy, Microscopy, Diffraction

- FTIR with various accessories (ATR, DRIFTS, Gas Cells, TGA-FTIR)
- Raman Microscopy
- UV-Vis Spectrophotometry
- NMR
- XRD, XPS, XRF
- SEM
- AFM
- Interferometry
- MS, GCMS

• Zeta Potential

Physical Properties

• Mechanical tests
• BET Surface Area
• Particle Size & Shape
• Rheometry
• Pyknometry
• Porosimetry
• Dynamic Vapour Sorption
• TGA-DTA (coupled to FTIR/MS for Evolved Gas Analysis)
• DSC (normal and high pressures)
• Chemisorption (Temperature Programmed Adsorption, Desorption, Reduction, Oxidation)
• GC & HPLC
• Total Organic Carbon & Chemical Oxygen Demand

Process Simulation

• Aspen Plus, ScimSci Esscor PRO/II, ChemCAD, SuperPro Designer, gPROMS
• Numerical Computing and Programming: MATLAB & SIMULINK
• Statistical Analysis: Stat-Ease DESIGN-EXPERT (Response Surface Method), SIGMAPLOT

Unit Control & Data Acquisition/Analysis

• Bruker Optics OPUS, JASCO Spectra Manager-II (FTIR)
• Seiko MUSE Thermal Analysis, Netzsch Proteus, PerkinElmer Pyris (TGA-DTA, DSC)
• Agilent ChemStation (GC & HPLC)
• Shimadzu TOC-Control
• Micromeritics AccuPyc II (Pyknometer) and AutoPore IV (Porosimeter)
• IGI Brooks SMART Interface and SmartControl (Mass Flow Controllers)

Computer-Aided Design

• SOLIDWORKS, AUTOCAD, MS VISIO, Adobe PHOTOSHOP

Webpage Design

• Adobe DREAMWEAVER, Contensis Content Management System (CMS)

Office Packages

• Word, Excel, Powerpoint, Project, OneNote, Outlook, Access

Papers

C. T. Alves, A. S. de Oliveira, S. A. V. Carneiro, R. C. D. Santos, S. A. B. Vieira de Melo, H. M. C. Andrade, F. C. Marques, E. A. Torres. Transesterification of waste frying oils using ZnAl2O4 as heterogeneous catalyst. **Procedia Engineering**. 2012

F. C. Marques, R. C. D. Santos. Carbon Dioxide Capture and Utilisation for Composite Materials. 2012. *In prep*.

Presentations

Carbon Dioxide Capture and Utilisation for Composite Materials

• Separation Technologies for Carbon Dioxide Capture - IChemE Fluid Separations Subject Group (23/09/2011 at Swansea University)

• **CCS from cradle to grave: The technical and safety challenges (https://www.icheme.org/communities/subject_groups/safety%20and%20loss%20prevention/events/2012/ccs%20cradle%20to%20grave%2022%20march%202012.aspx)** - IChemE Safety & Loss Prevention Special Interest Group (22-23/03/2012 in Birmingham)

• **CO2Chemistry <=> CO2ChemEng (http://co2chem.co.uk/co2chemistry-co2chemeng-april-2012)** - Department of Chemical and Biological Engineering (3-4/04/2012

Posters

Carbon Dioxide Capture and Utilisation for Composite Materials

• Research Poster Conference - Graduate School at the University of Birmingham (yearly)

• Separation Technologies for Carbon Dioxide Capture - IChemE Fluid Separations Subject Group (23/09/2011 at Swansea University)

• **CCS from cradle to grave: The technical and safety challenges (http://www.icheme.org/CCSCradletoGraveMarch2012)** - IChemE Safety & Loss Prevention Special Interest Group (22-23/03/2012 in Birmingham)

• **CO2Chemistry <=> CO2ChemEng (http://co2chem.co.uk/co2chemistry-co2chemeng-april-2012)** - Department of Chemical and Biological Engineering at the University of Sheffield (3-4/04/2012)

Other Events

• **Sustainability Live! (http://www.sustainabilitylive.com/)** (NEC, Birmingham)

• Energy Conference (University of Birmingham)

Responsibilities

Postgraduate Student Demonstrator

Provide academic support for chemical engineering undergraduate students during lectures, seminars, tutorials and experimental sessions, as well as marking coursework and tests, for the following modules and academic activities:

• MEng Research & Development Project, Level Masters, Year 4: created research projects for students based on my own PhD work, and provided trainining and supervision for the students to be able to work independently, effectively and safely.

• Design & Professional Skills **A (/undergraduate/studyabroad/modules/data/13/56/13/01/71/17113.aspx)** and **B (/undergraduate/studyabroad/modules/data/13/56/13/01/71/17114.aspx)** (DPS), Level Intermediate, Year 1: including Technical Drawing, using AutoCAD to create equipment parts, Process Flow Diagrams (PFDs) and Pipe and Instrumentation Diagrams (P&IDs). Also guided students in the preliminary design of a styrene plant, involving material and energy balances for various unit operations, plant costs and drawing equipment, as well as considering **safety and loss prevention (/undergraduate/studyabroad/modules/data/13/56/13/01/71/17114.aspx)** regulation;

• **Fluid Dynamics, Heat Transfer & Thermodynamics (/undergraduate/studyabroad/modules/data/13/57/15/02/18/21831.aspx)** (FTH), Level Intermediate, Year 1;

• **Chemical & Biochemical Processes (/undergraduate/studyabroad/modules/data/13/56/13/01/70/17043.aspx)** (CBP), Level Intermediate, Year 2;

• **Computing for Design (/undergraduate/studyabroad/modules/data/13/56/13/01/71/17127.aspx)** (CfD), Level Intermediate, Year 2;

• Laboratory experiments on the temperature control and pressure variation in fluidised beds, gas absorption in batch stirred tanks, temperature and flow control in heat exchangers, flow and pressure drop control in tubes, flow and power input control in insulated pipes;

• **Product Design Exercise (/undergraduate/studyabroad/modules/data/13/56/13/01/71/17128.aspx)** (PDE), Level Intermediate, Year 2: helped students to formulate a novel product, including all aspects of its production, such as technical specifications, manufacture, marketing, health and safety and regulations.

Chemical Engineering Peer Mentor (/postgraduate/courses/pg-mentor-scheme/Mentor-EPS.aspx)

Offer advice about the School of Chemical Engineering, the courses available, facilities, laboratories, staff, areas of expertise and research groups to postgraduate students and potential applicants.

Research Experience Mentor (http://www.birmingham.ac.uk/generic/internships/mentoring/cecmentoring.aspx)

• Support undergraduate students who have been awarded a Research Experience Bursary, and are undertaking a research placement over the summer vacation;

• Help students prepare for and reflect on their research placement, by reviewing their progress in planning, developing skills for, and undertaking their work;

• Raise students' aspirations about postgraduate research.

Postgraduate Recruitment Assistant (https://intranet.birmingham.ac.uk/external/student-recruitment/index.aspx)

• Answer questions from prospective students in the Doctoral Researcher Enquiry Service (**DRES (/postgraduate/courses/enquiry.aspx)**) Centre, via e-mail and telephone. Advise applicants about the courses available, detailed programme overviews, the application process, writing postgraduate proposals, scholarships, accomodation, etc. Use Hobsons' Enrollment Management Technology (EMT) CONNECT CRM to manage student interactions and data;

• Represent the University on Higher Education Fairs throughout the UK;

• Use Adobe Dreamweaver CS5.5 to create webpages for Schools and Departments at the University;

• Collate information for prospectuses;

• Participate in promotional photos and films and help to edit them, e.g.:
(1) **Postgraduate study at the University of Birmingham (http://www.youtube.com/watch?v=aZ8I_OotDTo)**;
(2) **Staying Local - University of Birmingham (http://www.youtube.com/watch?v=249gls9briU&feature=player_embedded)**;
(3) **Meet our postgraduate students (/postgraduate/birmingham/pg-profiles.aspx)**;
(4) **Postgraduate Mentor Scheme - EPS (/postgraduate/courses/pg-mentor-scheme/Mentor-EPS.aspx)**.

Student Ambassador (http://www.graduateschool.bham.ac.uk/studentambassadors.shtml)

• Help to organize, administrate and run Open Days, Higher Education Fairs, Applicant Visit Days, School Visits and Campus Tours at the University;

• Give presentations and advice to potential applicants and parents, from diverse backgrounds, about higher education, various aspects of student life, the facilities offered at the University, acting as their guide;

• Participate in promotional photos and films.

Website Content Editor (https://intranet.birmingham.ac.uk/it/web-services/index.aspx)

• Transfer, update and add Content to the University's website using Contensis Content Management System (CMS) as part of the Web Services Team;

• Involved since the launch of the new website, during the recent redevelopment of the web pages, focusing on projects to move the rest of the website across into the new brand and CMS;

• Work on staff and student profiles, courses, schools & departments, and mapping the old websites across the University.

Honors and Awards

Hufton Postgraduate Scholarship (April 2012)

This award is intended to financially assist academically meritous postgraduate research students from the engineering schools.

Guest Keen and Nettlefolds Scholarship (July 2011)

This award is intended to financially assist academically meritous postgraduate research students from the engineering schools.

Doctoral Researcher Studentship (October 2010 - July 2014)

This Studentship is available to outstanding candidates of the highest academic aptitude holding an offer of a place to study on a PhD in Chemical Engineering at the University of Birmingham.
A successful applicant will typically be top of their cohort of undergraduate students.
The applicant’s profile of marks will be exemplary (equivalent to high first class).
Their references will attest to qualities of academic achievement or research potential that make the candidate stand out above their peers.

They may have won prizes within their institution, or even international prizes.

Doctoral Researcher Sponsorship (September 2010 - July 2014)

This award is sponsored by the industrial partner **CCM Research Ltd (http://www.ccmresearch.co.uk/ccs.html)** to fund the candidate undertaking a PhD project.

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