

Catalytic strategies for the conversion of CO₂ into valuable products

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CO₂ capture and utilisation is a central research topic in the context of green chemistry and sustainability. The use of CO₂ feedstock is attractive not only in order to decrease the concentration of this greenhouse gas in the atmosphere but also because CO₂ is a non-toxic, inexpensive, widely-available, renewable and thus green C₁-feedstock. However, the conversion of CO₂ into useful products is a challenging target, due to the high thermodynamic stability of this molecule. There are two main strategies to overcome this limitation: (i) provide energy, *e.g.* in the form of electricity (electrochemical conversion); (2) react CO₂ with high free energy compounds (*e.g.* H₂, epoxides). In both cases, a catalyst is essential to improve the kinetics of the process and achieve the efficient conversion of CO₂ into selected valuable products. In this presentation, you will hear about our recent research achievements in the context of CO₂ conversion, using different catalytic approaches ranging from homogeneous to heterogeneous catalysis and finally touching electrocatalysis.

Curriculum vitae

Prof. Dr. Paolo P. Pescarmona

Personal details

Place and date of birth: Torino, Italy, 02/11/1973

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Current position

Full Professor in Catalysis & Sustainability at the University of Groningen, the Netherlands (since April 2022). My research approach involves the rational design and development of catalytic materials for applications of academic, industrial and societal relevance, with a special focus on green chemistry. All aspects of the development of catalysts (heterogeneous and homogeneous) are covered: from the synthesis to the characterisation and testing. The targeted applications include CO₂ utilisation, biomass conversion, selective catalytic oxidations, electrocatalysis and photocatalysis.

Education and past work experience

- 2022-current: Full professor at the University of Groningen, the Netherlands.
- 2017-2022: Associate professor at the University of Groningen, the Netherlands.
- 2017: Visiting professor at the University of Torino, Italy.
- 2014-2017: Assistant professor at the University of Groningen, the Netherlands.
- 2014-2017: Guest professor at the University of Leuven (KU Leuven), Belgium.
- 2008-2014: Assistant professor at the University of Leuven (KU Leuven), Belgium.
- 2005-2008: Post-doc researcher at the University of Leuven.
- 2004-2005: Researcher at Process Design Center B.V., Breda, the Netherlands.
- 2003-2004: Post-doc researcher at the Ceramic Membrane Centre 'The Pore', Delft University of Technology.
- 2003: Ph.D. (cum laude) from the Delft University of Technology (TU Delft), the Netherlands.
- 1997: Master Degree in Chemistry (110/110 cum laude et mentione) from the University of Torino, Italy.

Publications

- 112 articles in international peer-reviewed scientific journals, including 3 in *Angew. Chemie*, 12 in *Green Chem.*, 6 in *ChemSusChem*, 4 in *ACS Sustainable Chem. Eng.*, 1 in *ACS Catal.*, 4 in *Appl. Cat. B*, 6 in *J. Catal.*, 4 in *Catal. Sci. Technol.*, 3 in *Chem. Commun.*, 1 in *JACS*, 2 in *J. Mater. Chem. A*. First or corresponding author in > 75% of the publications, h-index = 44, > 7000 citations, average IF > 7.
- 5 chapters in scientific books.
- 4 international patents.

Presentations

- 40 oral presentations at international conferences, of which 12 as invited plenary or keynote speaker, including: CBCAT (2023), ICOMC28 (2018, Italy), ICC16 (2016, China), IZC18 (2016, Brazil), Europacat12 (2015, Russia), Europacat11 (2013, France), IZC17 (2013, Russia), ISGC-2 (2013, France), Europacat10 (2011, Scotland), ICC14 (2008, Korea), Europacat8 (2007, Finland).
- 22 invited lectures at universities or research institutes.

Supervision

- Current research group: 1 post-doc, 9 Ph.D. students, 3 Master students.
- Past: 10 post-docs, 15 Ph.D.s, 30 Master students (all these students obtained their title).

Teaching

- Deputy Director of the Master program in Chemical Engineering at the University of Groningen (1/2019-6/2023).
- Teacher of the year 2017-18, Degree programme in Chemical Engineering, University of Groningen.
- Current: lecturer of 'Design of Industrial Catalysts', 'Industrial Organic Chemistry and Catalysis' and 'Green Chemistry: Technological Societal and Ethical Aspects' for the Bachelor and Master in Chemical Engineering, Chemistry and Industrial Engineering and Management of the University of Groningen; mentor for the graduate course "Mastering your PhD" of the Graduate School of Science and Engineering of the University of Groningen.
- University Teaching Qualification obtained in 2015. This is a proof of didactic competence for lecturers in academic education recognised by all Dutch universities (http://www.vsnu.nl/en_GB/teacher-quality.html).

Other scientific and management activities

- President of the Dutch Zeolite Association (DZA), Member of the Board of the Federation of European Zeolite Associations (FEZA) (since 9/2016) and Secretary of FEZA (since 1/2024).
- Member of the Board of the Dutch Catalysis Society (DCS, since 2017).
- Chair of the Board of the Engineering and Technology institute Groningen (ENTEG), University of Groningen (since 1/2023).
- Session organiser for international conferences: Chains2017, CMD26, Europacat11 (*i.e.* the major European congress in the field of catalysis, 2013, France), NCCC14, NCCC17 and NCCC18 (2013, 2016 and 2017, the Netherlands).
- Chairman at international conferences: IZC18 (2016, Brazil), CCDC (2016, Portugal), Europacat13 (2015, Russia), Europacat11 (2013, France), ISGC-2 (2013, France), NCCC14, NCCC17 and NCCC18 (2013, 2016, 2017, 2023, 2024, the Netherlands), Europacat10 (2011, Scotland), Eurocombiat9 (2009, Spain).
- Referee for various prominent international journals in the fields of chemistry, catalysis and sustainability and for funding institutions in various European countries.
- Main applicant and principal investigator for projects financed by different institutions or industrial partners. Most recent projects: *D-Carbonize*, joint doctorate network involving several EU universities, institutions and companies (HORIZON-MSCA, 2023-2026, 4 Double-degree PhDs), *Epoxy-CO₂ project for the synthesis of CO₂-based polycarbonates*, financed by a company in Italy (235 k€, 2019-24). *Release: Reversible, Large-scale Energy Storage*, (NWO, 2020-23, post-doc for 2 years); *Electrons to Chemical Bonds (E2CB)*, NWO-TTW Perspectief, Dutch funding (2019-2023, total budget: 3463 k€). *Hydrohub MW Test Centre for Water Electrolysis* (NWO, Consortium with ISPT, Hanze Hogeschool Groningen and several Companies, RUG: 310 k€ *i.e.* one PhD for 4 years). *Development of innovative adsorbents for selective separation of CO₂ from (bio)gas*, PhD project financed by DMT and SNN (2018-2022, budget 310 k€). *RECODE - Recycling carbon dioxide in the cement industry to produce added-value additives: a step towards a CO₂ circular economy*, H2020 funding from the European Union, Call SPIRE-08-2017 (2017-21; budget for the University of Groningen: 539.6 k€; total budget: 7904 k€). *Redfosfaat*: industrial project for the sustainable recovery of phosphate salts (2017-18; RVO, budget: 153.2 k€).
- International scientific collaboration (ongoing and past): ICIQ Tarragona, Spain (Prof. Arjan Kleij); University of Bologna, Italy (Prof. Fabrizio Cavani); University of Namur, Belgium (Prof. Carmela Aprile); Polytechnic University of Torino, Italy (Prof. G. Cicero, Prof. Sonia Fiorilli, Prof. Claudio Gerbaldi); Harbin Institute of Technology, China (Dr. Kaifeng Lin); Federal University of ABC, Brazil (Prof. Dalmo Mandelli and Prof. Wagner Alves Carvalho).

Languages

- Italian: mother tongue.
- English: full professional proficiency.
- Dutch: very good (C1 certificate: Effective Operational Proficiency - ITNA test).
- Spanish: very good.
- French: very good (Alliance Française Diploma).
- Portuguese: good.
- Turkish: basic.