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INSIGHT SEMINAR: From concept to application: A holistic Sorbent-based Materials Discovery Approach for Industrial Decarbonisation

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May 15, 2025
12:00 to 13:00
Seminar Room

ABSTRACT:
The urgent need for affordable, sustainable, and environmentally friendly technologies to meet current and future energy demands has driven scientists and industrialists to seek impactful industrial-scale solutions. Innovations in materials design, particularly in gas separation processes such as carbon dioxide (CO2) capture, have gained significant attention. CO2, largely from fossil fuel use and major industrial processes (e.g., steel, cement), is a major contributor to global warming. To significantly impact Net Zero Greenhouse Emission targets, technologies like carbon capture, utilization and storage

(CCUS) must remove gigatonnes of CO2 annually.
Sorbent-based carbon capture, using porous materials like Metal-Organic Frameworks (MOFs), separates CO2 from gas streams (e.g., flue gas, industrial gas, or air via Direct Air Capture). Achieving efficient, sustainable, and cost-effective operations at scale requires reducing energy demands and costs. Innovations in material design, driven by computational techniques and reticular chemistry, have focused on identifying optimal MOF adsorbents. Despite progress, research often lacks a systems approach that spans disciplines and scales, necessary to overcome market entry barriers.
This seminar reviews our recent developments in designing a materials innovation pipeline that addresses process requirements at scale. By integrating materials and process design with technoeconomic and environmental performance indicators, we developed tools to expedite material discovery and direct R&D towards feasible, scalable performance goals. This systems-based approach accelerates the market entry of cost-competitive, low-impact, resource-efficient sorbent-based carbon capture technologies. A similar approach can be developed for other separations and systems beyond carbon capture, and a few examples will be presented. By establishing the materials composition-structureperformance relationship and by cleverly designing materials and anticipating their required systemslevel performance, we can ultimately provide guidance for the development of more advanced, nextgeneration materials for cost-competitive and efficient separation processes in energy, industrial and environmental applications.

BIO:

Prof. Susana Garcia received her PhD in Chemical Engineering from the University of Nottingham (UK) in 2010 and conducted post-doctoral research at the Spanish National Carbon Research Institute
(INCAR-CSIC) before joining Heriot-Watt University (HWU) in Edinburgh (UK) as an Assistant Professor in 2014. In 2017, she became the Associate Director in Carbon Capture, Utilization and Storage at the Research Centre for Carbon Solutions (RCCS), an interdisciplinary world leading engineering centre, inspiring and delivering innovation for the wider deployment of technologies needed to meet necessary carbon targets. She was appointed to Associate Professor in 2019 and to Full Professor of Chemical and Process Engineering in 2021. In 2023, Prof Garcia received a Visiting Professor Award to move to Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland, and in 2024 she was named Global Head of the Institute of Mechanical, Process and Energy Engineering at Heriot-Watt University.
Prof. Garcia's research program focuses on advancing materials and separation processes for energy, industrial and environmental applications. Her team has changed the paradigm on how novel processes based on advanced materials are designed through the integration of process engineering and fundamental science. She has published more than 80 peer-reviewed journal articles (i.e., in Nature, Nature Materials, Science Advances, Energy and Environmental Science), reports for companies and participated in more than 100

national and international conferences and workshops. In recognition of her outstanding professional trajectory, she received the SRUK Emerging Talent Award in 2020 by the Society of Spanish Researchers in the UK and sponsored by the Banco Santander Foundation under its i¿½Young Talenti¿½ programme. Her leadership roles include participation in fun
ing agencies' peer review panels of research centres of excellence and prestigious grants and fellowship programmes; Scientific advisor to companies, foundations, and other invest
rs; and Member of Scientific Societies.

Hosted by: Prof. Dr. F. Pelayo Garcia de Arquer