Green Chemistry TechHub – A Trilateral Doctoral Program

The Green Chemistry TechHub is a joint doctoral training program established by TU Wien (TUW), the University of Natural Resources and Life Sciences (BOKU), and the University of Vienna (UV). Funded by the Austrian Research Promotion Agency (FFG) and supported by a robust network of industry partners, the program is dedicated to advancing innovation in sustainable and environmentally responsible chemistry through interdisciplinary research and academic–industry collaboration.

We are currently offering 8 fully-funded PhD positions across the three institutions:

- 4 Positions at TU Wien (TUW)
- 2 Positions at BOKU University (BOKU)
- 2 Positions at University of Vienna (UV)

Each doctoral researcher will engage in a four-year research program, spending **up to 3 years at the academic institution** and **1 year embedded with an industry partner or continued employment at the academic institution with a secondment placement at industry**, gaining valuable cross-sector experience in applied green chemistry and biotechnology. The positions are equivalent to part-time university assistantships (30 hours/week) and offer competitive remuneration according to FFG guidelines and the respective university's pay scale, including full social benefits.

We offer:

- An interdisciplinary, applied research setting within the **Green Chemistry TechHub**
- Exposure to both academic excellence and real-world industrial challenges
- Hands-on experience with advanced tools and methodologies in sustainable biotechnology
- Competitive funding and access to professional development resources
- Diverse and cutting-edge research projects
- Continuing personal and professional education
- Additional optional training as a Green Chemistry Change Manager (GCCM)
- High-quality supervision by renowned scientists
- Ample opportunities for international networking, secondments, and research collaboration
- Courses on transferable skills
- Comprehensive social benefits (e.g., health insurance)
- Administrative support in study and organizational questions
- A central location in Vienna—consistently ranked as the city with the best quality of life
- A dynamic and inclusive working environment

Applications:

Application Process: Applications will be reviewed on a rolling basis until the position is filled.

At the Green Chemistry TechHub consortium we are committed to equal opportunity and strive to increase the representation of women within scientific staff across all partner institutions. Therefore, we strongly encourage qualified women to apply. Female applicants will be given preferential consideration when their qualifications, aptitude, and professional performance are comparable to those of male applicants. Additionally, persons with disabilities are especially encouraged to apply.

Applications should be submitted online via the TU Wien job portal.

Required Documents:

- A **cover letter** listing three preferred PhD topics from the project list (ranked with motivation)
- A **curriculum vitae**, including publications, conference contributions, and other scientific activities (if applicable), preferably using the Europass template
- A **one-page summary** of the diploma/master's thesis
- **Transcripts** of records of the Bachelor- and Master-studies
- A **one-page outline** on how you would approach the proposed project

Selection Process:

Shortlisted candidates will be invited to participate in a **video or face-to-face hearings**, which will include:

- A presentation on previous research projects
- A short discussion of a thematically related publication (article sent one week in advance)
- A critical reflection on the proposed implementation of the selected project

This multi-stage process ensures a comprehensive evaluation of technical expertise, strategic thinking, and alignment with project objectives.
For further information about the open positions or the application procedure, please contact the Project Manager, Muhammad Farooq Zia (muhammad.zia@tuwien.ac.at), or reach out to one of the project leaders.

Positions (English):

Position 1. Biotechnological methanol valorization (BOKU/New Path Bio)
Position 2. Production of biochemicals based on biodiesel and bioethanol waste (BOKU/Vogelbusch)
Position 3. Membrane separation process for CO_2 (TUW/VOESTalpine)
Position 4. Sustainable polymer processing (UV/BASF)
Position 5. Starch modification (TUW/Agrana)
Position 6. Sustainable isotope labeling (UV/Boehringer Ingelheim)
Position 7. Solvent-free reaction cascades using mechanochemistry (TUW/RDP)
Position 8: Development of a modular polysaccharide platform using click chemistry (TUW/Agrana)

Positions (German):

Position 1: Biotechnologische Methanol Valorisierung (BOKU/New Path Bio)
Position 2: Lentilactobacillus Plattform (BOKU/Vogelbusch)
Position 3: Membranseparationsprozess für CO_2 (TUW/VOESTalpine)
Position 4: Nachhaltige Polymer-Prozessierung (UV/BASF)
Position 5: Stärkemodifikation (TUW/Agrana)
Position 6: Nachhaltiges Isotopenlabelling (UV/Boehringer Ingelheim)
Position 7: Lösungsmittelfreie Reaktionskaskaden mittels Mechanochemie (TUW/RDP)
Position 8: Modulare Polysaccharid-Platform mittels Click Chemie (TUW/Agrana)

Position 3:

Membrane Separation Processes for the Separation of CO_2 from Process Gas Streams in the Iron and Steel Industry

The reduction of hard-to-abate CO_2 emissions from many industrial processes in the iron-and-steel and other metallurgical industries, cement industry, during the production of bricks and other construction materials and various other sectors may require the separation of CO_2 from process gases, flue gas and other waste streams. The separated CO_2 can be stored according to carbon capture and sequestration (CCS) concepts, or, even better, considered as a carbon source for carbon capture and utilization (CCU) approaches relevant for the industrial partner.

Various technologies have been investigated in the last decades to separate CO_2 from flue gas streams of combustion processes. Conventional amine absorption and CO_2 adsorption are widely accepted process routes; however, these technologies suffer from high thermal and electrical energy consumption, which may reach up to 30% of the energy produced from fuel combustion. Further, specific energy consumption depends on the initial CO_2 concentration in the flue gas and increases with lower CO_2 feed concentration and higher CO_2 recoveries.

Process gas streams from iron-and-steel production may provide additional challenges: dust, other gas constituents apart from carbon dioxide, oxygen, nitrogen and water vapor, additional critical toxic or corrosive contaminants as well as challenging process conditions with regard to pressure, temperature and varying flow rates and required recovery ratios.

Membrane gas separation processes for the recovery of CO_2 have recently gained more attention due to the availability of high-flux membranes with better selectivities and improved mechanical, thermal and chemical stability (Fig.1, Fig. 2). Further, membrane separation processes usually do not require liquid or solid media as in absorption or adsorption processes which need cyclic regeneration and are thus prone to a quick loss of performance and/or require make-up and frequent exchange of the operating media. Membrane gas separation processes can be operated in continuous mode with usually lower hardware and process control needs.

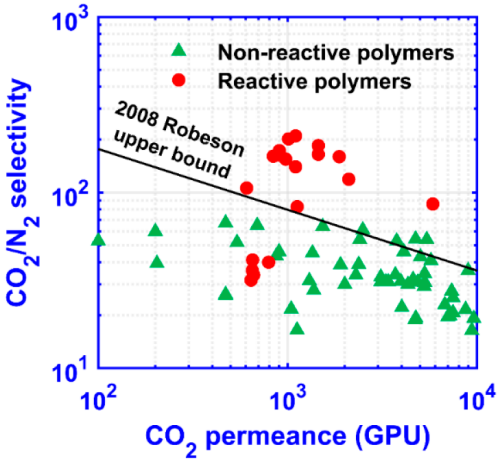
In this PhD thesis, the latest developments in membrane gas separation for the recovery of CO_2 shall be reviewed and rated with regard to their applicability to the CO_2 separation from process gases in the iron-and-steel industries – including process gas composition information of selected processes from the industrial partner voestalpine. Generic, fully integrated process simulation models shall be developed which can be calibrated with membrane performance information from this review. The integrated model library shall include pre-treatment needs, single or multi-stage membrane separation as the core feature, further upgrading requirements of the separated CO_2 streams considering possible CCU scenarios, heating and cooling needs, wetting and drying needs and aspects with regard to maximizing driving forces for the membrane separation process, e.g. compression or vacuum operation. From the initial simulation results, minimum membrane performance requirements will be derived to meet separation goals.

Based on these findings, promising membranes and process conditions shall be selected and tested under varying lab conditions using the fully automated multi-component dynamic gas-mixing units available in the gas separation lab at TU Wien, ICEBE. In addition, membrane production and coating equipment operated in the gas separation lab at TU Wien, ICEBE, may allow to produce so-called hollow fiber membranes or apply additional coating to commercial hollow fiber membranes through

the prototypic continuous fiber coating equipment also available at TU Wien to achieve improved separation performance – dependent on the findings from the initial lab test campaigns. Prototypic membrane modules shall be prepared, for tests both at TU Wien and in the labs of voestalpine in case of promising performance.

The experimental results shall be used for a refinement of the process simulation library established and calibrated from initial literature findings and – in cooperation with voestalpine – relevant application scenarios shall be defined and evaluated with regard to key performance indicators (KPIs) such as CO_2 recovery, operational limits, specific energy consumption, required number of membrane modules and specific membrane area. Amine absorption shall be considered as a reference case and benchmark.

Finally, in the last year of this PhD project, possible implementation scenarios at voestalpine production sites and use cases for the separated CO_2 shall be evaluated – targeting CCU strategies in particular.



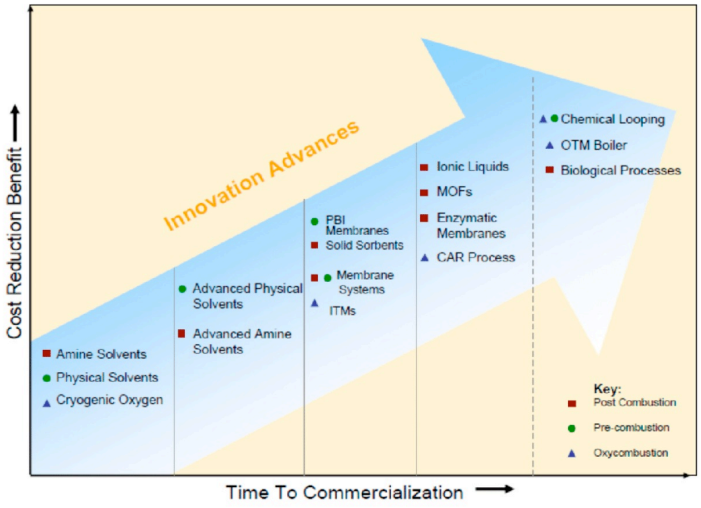


Fig.1 (left): Transport properties of selected reactive and non-reactive polymers [1]
Fig.2 (right): Cost reduction benefits vs. time to commercialization for technologies in CCU [1]

[1] Han et al.: Recent Progress in the Engineering of Polymeric Membranes for CO_2 Capture from Flue Gas. Membranes 2020, 10, 365; doi:10.3390/membranes10110365