PERSONNEL SCIENTIFIQUE

PhD position (f/h/x) – Structuring of moisture-insensitive adsorbents for CO2 capture

Votre mission

Throughout the last years, a significant increase in CO2 emissions have been observed which are mostly caused by anthropogenic activities. Since CO2 emissions continue to steadily increase every year, it is considered as the primary driver of climate change and one of the most pressing challenges. Therefore, more and more research has been dedicated to the development of innovative processes to reduce the ecological impact of CO2 by capturing it preventively as well as using it as a building block for fuels, polymers and other valuable chemicals. CO2 could either be captured out of industrial flue gases or directly out of the air, also called Direct Air Capture. Most common approaches to capture CO2 include the use of liquid amine absorption, membrane separation or solid-state adsorption. Although amine absorption is currently the most applied commercially, their use is plagued by several drawbacks including solvent degradation, corrosion, evaporation and high energy consumption. On the other hand, membrane separation and their commercial applicability are highly challenged by a trade-off between permeability and selectivity.

A promising alternative is the separation and adsorption of CO2 by porous solid-state materials, which significantly reduces the amount of waste and the overall energy consumption. To obtain a highly efficient separation process, a solid adsorbent should contain several properties including a high CO2 adsorption capacity at the desired pressure and temperature range, fast ad- and desorption kinetics, low production costs and most importantly a high selectivity for CO2 over other gases and impurities. One of the most frequent challenges in CO2-adsorption processes includes the competitive adsorption of H2O vapor over CO2. Since this competition affects the overall uptake and adsorption performance significantly, a pre-treatment step is often needed which increases the total cost and process complexability.

The most attractive solid adsorbent materials typically involve activated carbons, zeolites, porous polymers, Metal Organic Frameworks (MOFs) and Covalent Organic Frameworks (COFs), each having their own advantages and disadvantages. Although carbon-based materials are extremely cheap and highly hydrophobic, their CO2-adsorption capacity at the lower pressure range is rather limited. In contrast to activated carbons, MOFs are showing a significantly improved CO2-adsorption capacity at lower pressures but are lacking the commercial availability and the scalability. One promising alternative includes the use of

 ich show a steep isotherm at the lower pressure range resulting in moderate to high adsorption

capacities. Although zeolites are readily available, current challenges include the high affinity for water vapor as well as the energy needed for regeneration in comparison with activated carbon and MOFs.

In this Doctoral Research, alternative CO2-adsorbents will be explored which show a high adsorption capacity at the relevant lower pressure range while possessing a high selectivity for CO2 over water vapor, so called moisture-insensitive adsorbents. Two routes will be investigated, including

• Adjustment of commercially available zeolites, i.e. hydrophobization by functionalization of the zeolite surface

• Screening of alternative CO2-adsorbents with high selectivity and capacity, including MOFs, ETS, …

To prevent any diffusion limitations and high pressure drops, the adsorbents will be structured on honeycomb substrates by a washcoating procedure. This will result in thin coatings of the adsorbent, enabling fast ad- and desorption cycles. Besides the conventional cordierite honeycomb support, alternative supports will be explored which show a high thermal conductivity as a basis for regeneration by Electrical Swing Adsorption (ESA) our Microwave Swing Adsorption (MSA).

Votre profil

• You hold a M.Sc. degree in either Chemistry, Chemical or Bio(chemical) Engineering or are student in MAB2.

• You are fluent in English, both oral and written.

• You take initiative and can work independently, while you keep on consulting and discussing with a team.

• You are creative, results-driven and can meet quality output with stringent deadlines.

• You are eager to disseminate your research results by scientific publications or communications at conferences.

Notre offre

VITO offers a PhD scholarship to the candidate for 4 years. The successful student will be enrolled at University of Mons. The university promotor for this PhD will be Prof. Guy De Weireld. At VITO, the PhD candidate will work within the CAST (Coating and Shaping Technologies) under the supervision of Dr. S. Mullens and Dr. B. Sutens.

Intéressé(e) ?

Applications should be submitted online and include a copy of your CV, diploma transcripts and a cover letter. Applications will be processed on a first come first served basis until a suitable candidate is found.

ıts graduating this academic year are welcome to apply.

Call for the next VITO PhD jury closes March 25, 2024.

More information is available on **PhD | VITO**.

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