VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Matthias Schoukens**

The public defense will take place on **Wednesday 27th August 2025 at 5 pm** in room **I.0.02** (Building I, VUB Main Campus)

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INTENSIFICATION AND ELECTRIFICATION OF ADSORPTION PROCESSES USING STRUCTURED ADSORBENTS WITH INDUCTION HEATING AS AN ALTERNATIVE REGENERATION METHOD

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Abstract of the PhD research

Gas separation and purification are essential steps in many industrial processes, especially in the chemical and petrochemical industries. These operations are not only complex but also very energy-intensive and they represent a significant portion of industrial costs. Improving these processes is crucial for making industry more sustainable and reducing its environmental impact. This thesis focused on developing new and more efficient methods for carbon capture. Capturing CO_2 is a key step in reducing greenhouse gas emissions and addressing climate change.

The major focus of this research was the application of magnetic induction heating in adsorption-based gas separation processes. Magnetic induction heating is a technique that uses magnetic fields to generate heat directly inside certain materials, allowing for fast, efficient, and targeted heating. In this work, special magnetic materials were developed that can heat up under a magnetic field. These were combined with materials that can absorb gases like CO_2 to form structured composite adsorbents suitable for use in separation processes. The aim was to improve how these systems capture and release gases by using induction heating to regenerate the adsorbent material more quickly and with less energy. These new materials and techniques were tested in various setups to evaluate their performance and to explore how the process could be optimized. This work also investigated how the technology might be scaled up for larger industrial applications while maintaining uniform and efficient heating. In addition to CO_2 capture, the potential of magnetic induction heating was also explored for other applications, such as drying gases.

Overall, this research advances the development of more efficient and sustainable gas separation technologies by demonstrating the benefits of applying magnetic induction heating to adsorption processes.