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Press Release

e-CODUCT Horizon Europe Project:
ELECTRIFICATION OF CATALYTIC REACTIONS AND REACTORS

EuropaCat 2025 conclusions and e-CODUCT technology progress

The Horizon Europe-funded projects e-CODUCT, EReTech, ēQATOR, TITAN and STORMING jointly organized a second workshop, this time at the 16th European Congress on Catalysis – EuropaCat 2025 in Trondheim. The workshop included three special sessions on **Electrification of Catalytic Reactions and Reactors,** providing a forum for scientists and researchers from academia and industry across Europe to discuss the latest innovations in the use of electricity to power catalytic reactions and reactors instead of traditional fossil resources. The sessions were chaired by **Prof Joris Thybaut**, (Ghent University, Belgium) and **Prof Patricia Benito Martin** (University of Bologna, Italy).

EuropaCat 2025 Conclusions

The three special sessions on Electrification of Catalytic Reactions and Reactors at EuropaCat 2025 provided deep insights into the latest technological developments and potential applications of electrification to reduce emissions, improve process performance and control and enable green chemistry.

Discussions focussed on **emerging electrocatalytic processes** for the sustainable production of fuels and chemicals, including hydrogen, methanol, and nitriles; **innovative reactor designs** such as inductively heated systems, microwave-assisted pyrolysis, plasma-assisted reforming and 3D-printed structures for Joule heating; **advanced catalyst development**, with materials tailored for high efficiency, durability and selectivity under electrified conditions; **operando monitoring approaches** for improved control of temperature, pH and heat distribution in electrified systems; and **pilot-scale demonstrations** showing progress towards industrial application, particularly in electrified methanol synthesis and sulphur recovery.

Overall, the sessions showed that electrification offers a **promising and scalable pathway to decarbonize chemical production while improving process control and efficiency**. *"Electrification is no longer just a scientific curiosity - it is rapidly becoming a practical pathway for cleaner and more efficient chemical processes. The results presented at EuropaCat 2025 show that the transition from concept to industrial application is within reach*," said Prof Joris W. Thybaut, coordinator of e-CODUCT (Ghent University).

The e-CODUCT project team at EuropaCat2025

The e-CODUCT project is funded under Horizon Europe Grant Agreement n°101058100

Progress in the development of e-CODUCT technology - methanol synthesis research

The e-CODUCT consortium has entered the final six months of its project, during which intensive and crucial research and demonstration activities are underway.

At the core of the e-CODUCT process is the **Electro-Thermal Fluidised Bed (ETFB) reactor**, a breakthrough technology that relies on renewable electricity for fast, precise, and efficient heating. Through a two-step catalytic process, the ETFB reactor converts CO_2 and H_2S into carbon monoxide and sulphur, turning harmful emissions into valuable resources. This innovation realizes up to 50% lower energy use and emissions compared to conventional methods, offering a cleaner and more economical pathway for industry. Following the **successful construction of the ETFB pilot line in Slovenia**, the consortium is now thoroughly **testing the equipment**. Stable operation of the ETFB reactor was achieved at 1000 °C for almost 50 hours under inert atmosphere.

The consortium has also investigated **methanol synthesis** over a $Cu/ZnO/Al_2O_3$ catalyst within a wide range of operating conditions. Parameters such as temperature, pressure, feed composition and WHSV were systematically varied, and the catalyst stability was evaluated in a 42-hour time-on-stream experiment. The study also evaluated potential operating windows and the estimated duration of the catalyst cycle before regeneration. In parallel, a pilot reactor for methanol synthesis was tested. The catalyst was loaded into the reactor, inertised and gradually reduced in hydrogen up to 280 °C. The pilot methanol reactor was successfully operated and **the first two kilogrammes of methanol** were obtained from a synthetic H_2/CO mixture at 45 bar and 230 °C.

The experimental data collected during methanol production showed that the use of CO_2 as the sole carbon source in the feed resulted in a lower methanol yield compared to the use of pure CO, while a CO/CO_2 mixture increased the methanol content. The results showed a clear dependence of **methanol production** on the operating conditions, with one of the three main reaction pathways, CO hydrogenation, CO_2 hydrogenation or reverse water gas shift, dominating depending on the operating mode. The effect of WHSV emphasised the role of residence time, with lower space velocities favouring higher methanol yields. Catalyst deactivation was moderate, with an 11.7% decrease in methanol mole fraction observed over 42 hours under high conversion conditions. These results provide a robust data set for the validation of kinetic models and will support the optimisation of industrial methanol synthesis reactors.

The observations have already been transferred to a **pilot methanol reactor** and validated with a synthetic CO and hydrogen stream. In addition, the ETFB reactor also demonstrated a stable operation at 1000 °C for 50 hours with inert gas. After some modifications and a series of leak tests, the feed gas will be switched to COS.

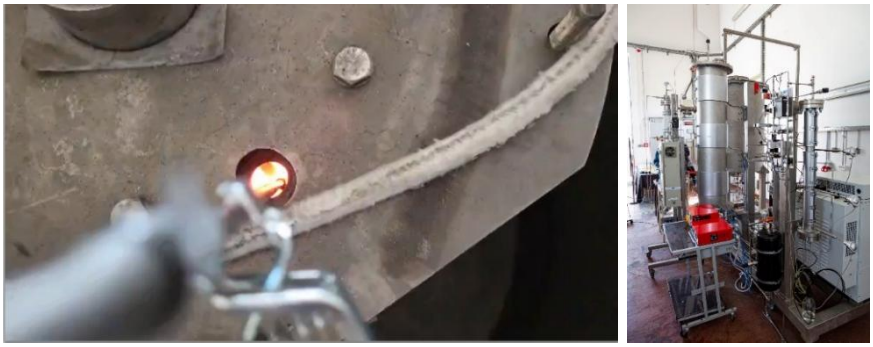

Figure 1 Fluidized-bed material glows at 1000 C in ETFB reactor. Methanol synthesis yielded 2 kg of MeOH on pilot scale.

The e-CODUCT consortium has presented its innovations and research results at leading international conferences, including **IZC 2025 - International Zeolite Conference** (China) and **ECCE2025 - 15th European Congress of Chemical Engineering** (Portugal).

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About e-CODUCT

The e-CODUCT project was launched in September 2022 and brings together nine leading European research institutions and industry partners from five European countries (Belgium, Slovenia, the Netherlands, France and Germany). The consortium aims to pioneer the electrification of catalytic reactors and reactions. By integrating renewable electricity into chemical production, the project aims to deliver low-carbon, resource-efficient, and economically viable solutions for industry. The e-CODUCT project is coordinated by Ghent University and funded under Horizon Europe Grant Agreement n°101058100.

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