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Electrified pilot line for methanol synthesis and sulfur recovery from acid gas

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Background and motivation. The growing focus on converting greenhouse gases and industrial waste streams into valuable products has driven the development of diverse technologies. Current acid gas treatment methods, such as the Claus process, primarily recover elemental sulfur, while CO_2 reduction processes require high-purity feedstocks to be effective. To date, no technology exists that enables the simultaneous reduction of H_2S and CO_2 while maintaining economic viability.

Materials and methods. The Horizon Europe project **e-CODUCT** (https://e-coduct.eu/) addresses the pressing environmental challenge of simultaneously reducing acid gas through an innovative two-step technology. In the first step, CO_2 and H_2S are converted into COS within a fixed-bed reactor over zeolite catalysts. The second step utilizes an electrothermal fluidized-bed reactor to transform COS into CO and S_x.

Results and discussion. The innovative e-CODUCT approach produces the platform molecule CO, which serves as a precursor for valuable chemicals and low-carbon fuels (*e.g.* methanol), alongside market-ready Claus-grade sulfur. The e-CODUCT project aims to overcome the limitations of existing methods, offering a sustainable and economically viable solution for industrial applications. Based on laboratory-scale data, a pilot plant was designed and constructed to demonstrate the second step of the e-CODUCT technology at TRL 6. This facility enables the collection of experimental data on COS decomposition in an electrified fluidized-bed reactor operating at temperatures up to 1200 °C. The process produces sulfur as a valuable product and utilizes the resulting CO stream for methanol synthesis in a downstream fixed-bed reactor. Data gathered from the pilot plant will support the validation of microkinetic models, as well as techno-economic assessment (TEA) and life-cycle analysis (LCA) of the e-CODUCT process.

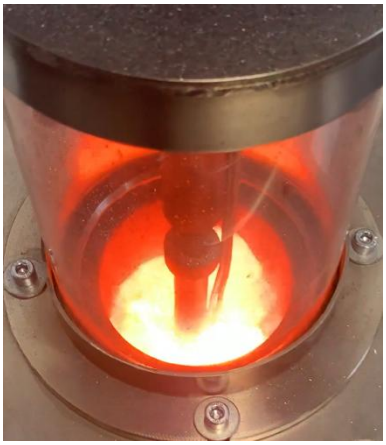

Figure 1. ETFB reactor prototype, operating at 1000 °C

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