e-CODUCT: Electrified COS decomposition and subsequent methanol synthesis

Aleksa Kojčinović[a,b], Blaž Likozar [a], Miha Grilc [a,b]

Aleksa.Kojcinovic@ki.si; Blaz.Likozar@ki.si; Miha.Grilc@ki.si

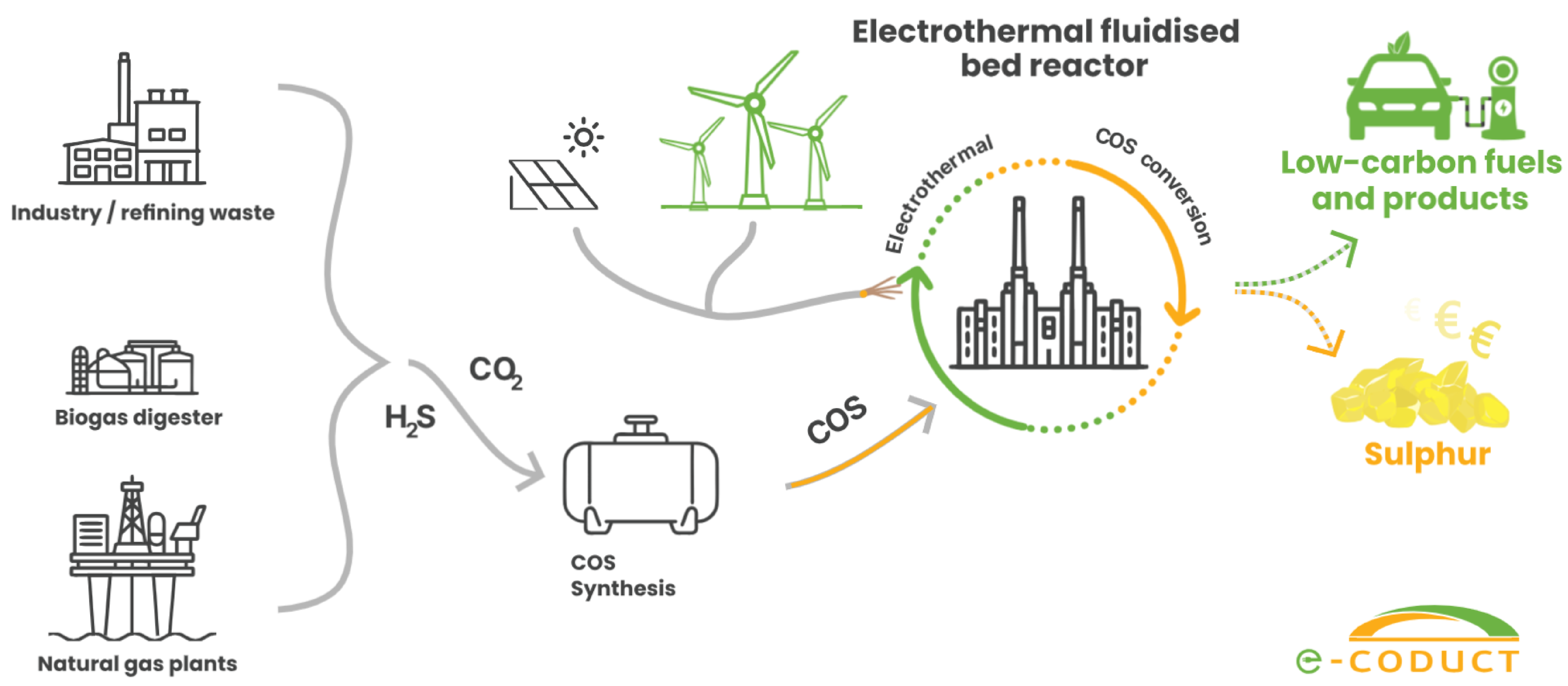
[a] ***Department of Catalysis and Chemical Reaction Engineering , National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia***

[b] ***University of Nova Gorica, Vipavska Cesta, 5000 Nova Gorica, Slovenia***

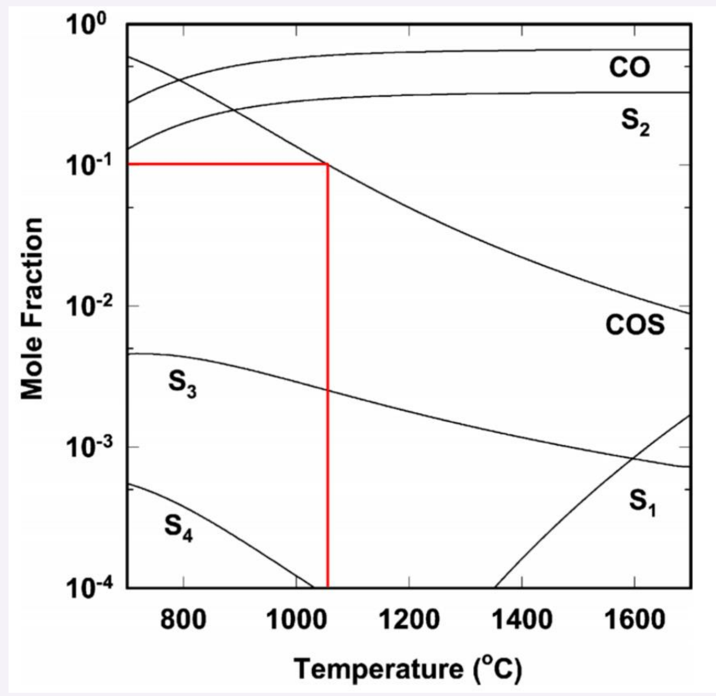
Introduction

Today, large quantities of CO_2 from heating and industrial processes are released into the atmosphere, with natural sequestration capturing about 2 Gt/year and technical sequestration (CCS) remaining limited due to high costs[1]. The industry valorizes only a small fraction of CO_2, lacking technologies to create a circular economy and significantly reduce emissions. Refineries and petrochemical industries emit 1.24 Gt/year of CO_2 and manage over 3.6 Mt/year of H_2S, a component of acid gas[2]. Current treatments, such as the Claus process, are inefficient for lean H_2S sources and require high-purity CO_2 for reduction or sequestration. e-CODUCT aims to address these issues by electrifying the simultaneous chemical conversion of CO_2 and H_2S into CO and marketable sulfur products. This new technology involves converting CO_2 and H_2S into COS in a fixed bed reactor, followed by converting COS into CO and SX using an electrothermal fluidized bed reactor. By potentially converting over 4.7 Gt/year of CO2, e-CODUCT could significantly reduce the carbon footprint of refineries and biogas treatment, becoming cost-competitive through reduced CO_2 taxes and CCS costs.

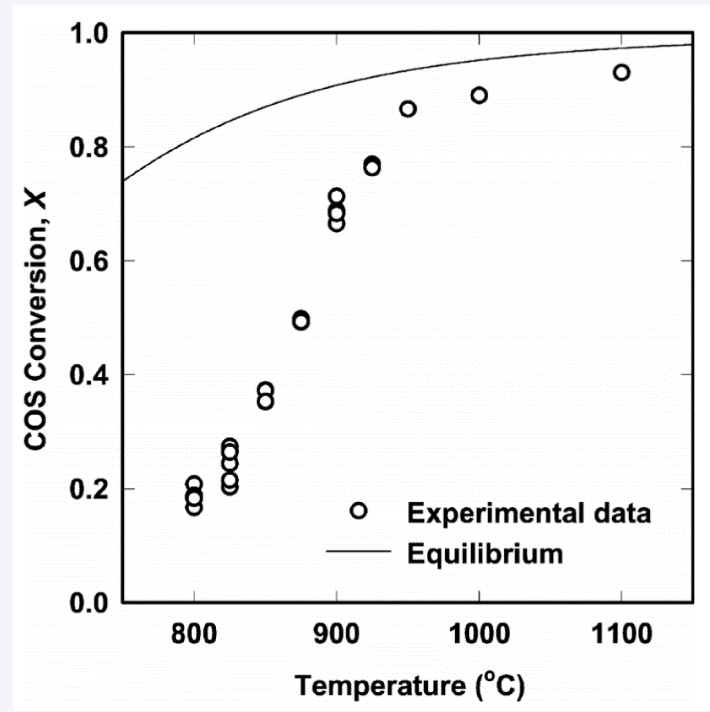
e-CODUCT process



COS Decomposition

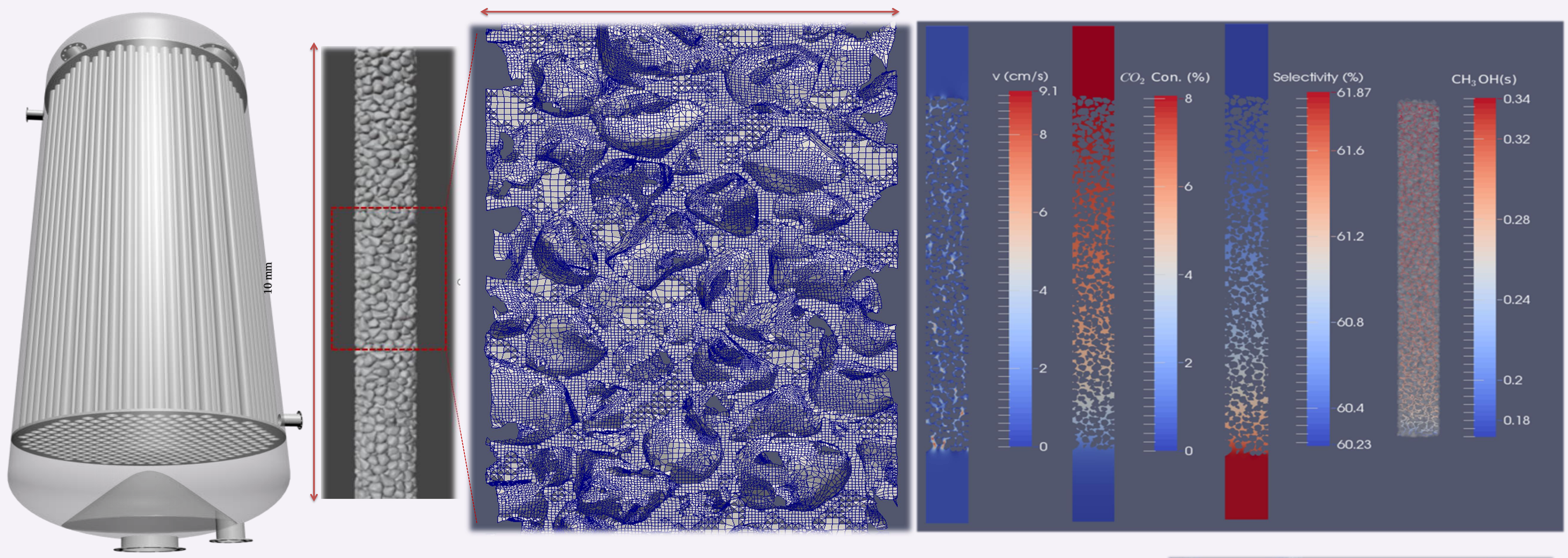


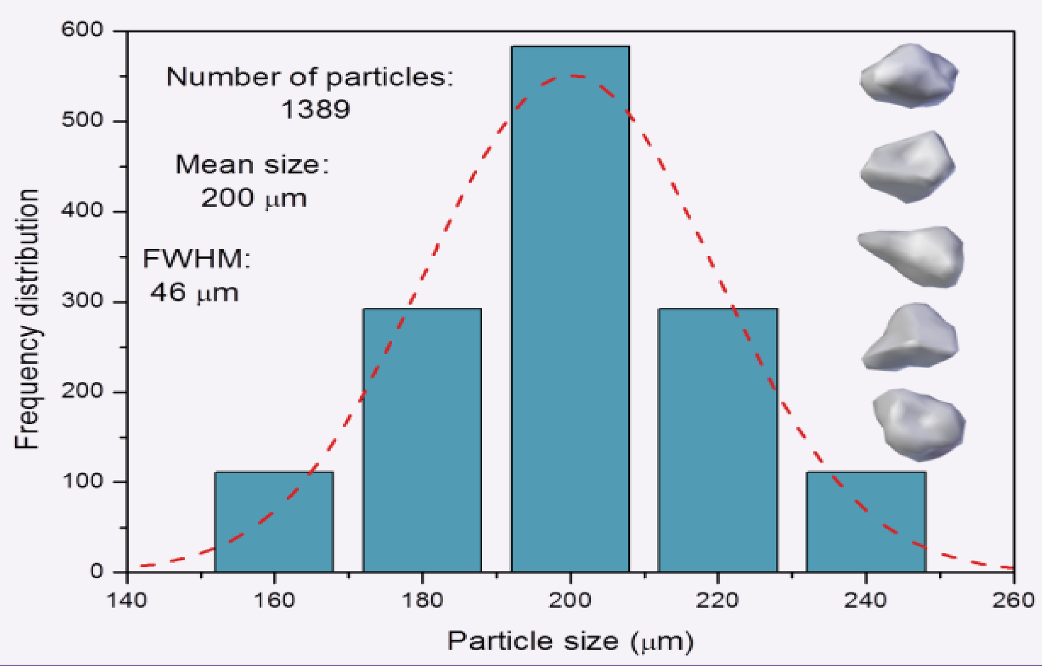
Equilibrium distribution of chemical species with pure COS as the feed. P = 101.3 kPa. 90% conversion at app. 1070 °C[3]

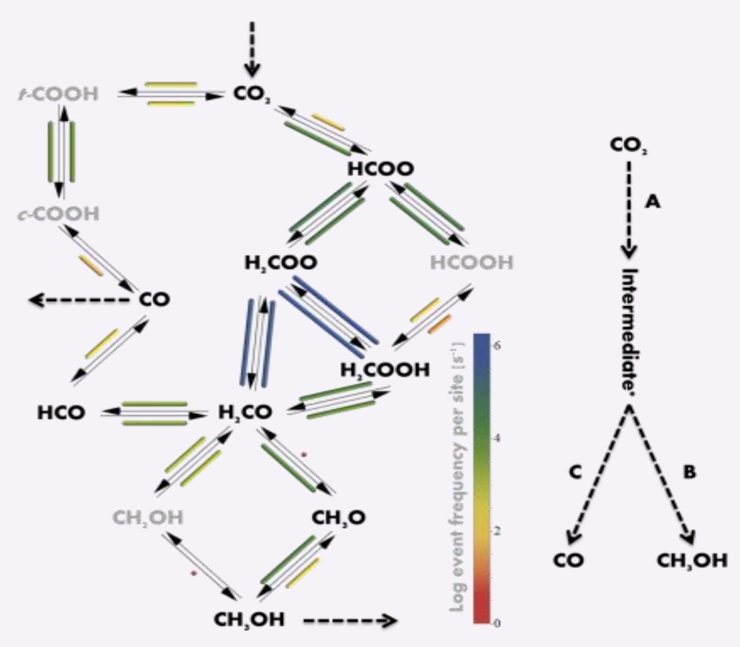


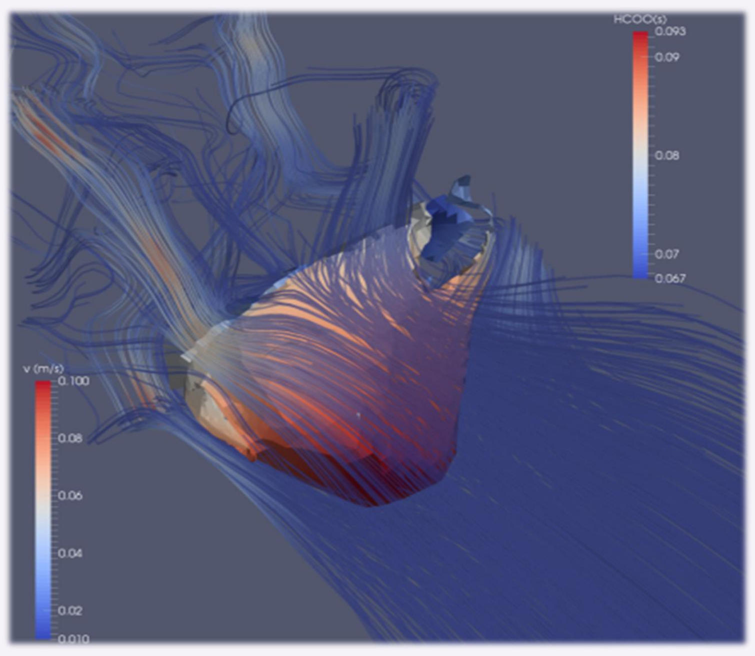
Experimental COS conversion as a function of temperature. 16 m reactor, 2.33 mol.% COS in feed. Residence time: 1.2 – 1.5 s[1]

Multi-scale modelling: CO hydrogenation: CFD









References

[1]Estimation based on announcements of relevant projects by CRI, Shell, Syneco, Vattenfall, Ineratec, Engie, EDL, Sunfire, Repsol

[2]The latter is estimated based on existing data on sulfur production in EU (Non-critical raw material factsheet, doi: 10.2873/587825) and CO2 emissions from refining sector (EU, Bloomberg and IFPEN data, Overview of the refining industry in the European Union Emissions Trading System (EU ETS))

[3]Karan, K., Mehrota, A. K., & Behie, L. A. (2005). Thermal decomposition of carbonyl sulphide at temperatures encountered in the front end of modified claus plants. Chem. Eng. Comm., 192(3), 370-385

Acknowledgments

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www. e–coduct. eu