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Coach	**Supervisor(s)**	**Funding**
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CO_2 utilization through Super-Dry Reforming

Aim

Process design for **CO_2 utilization** from a steel industry's gas to CO through **Super-Dry Reforming**.

Justification

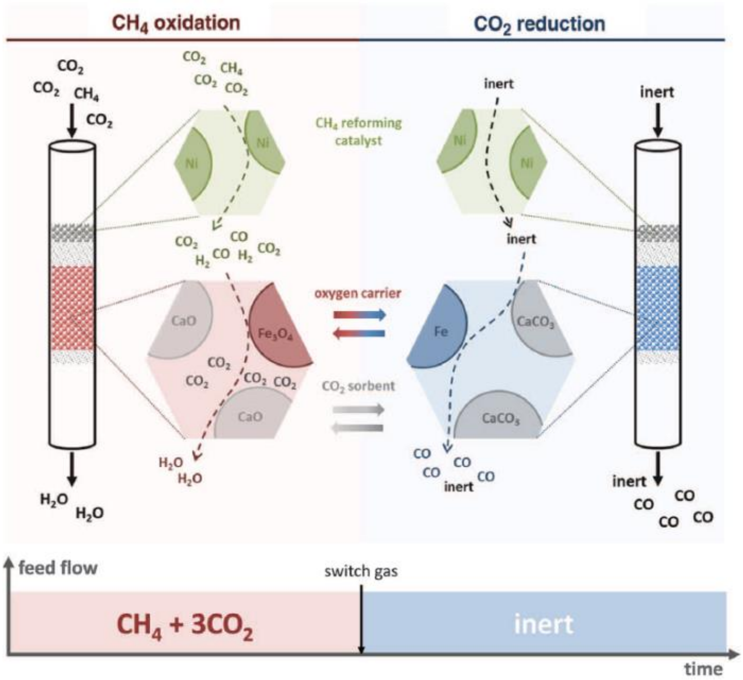

Figure 1. A schematic representation of the proposed Super-Dry Reforming process[2]

Steel production is an energy- and carbon-intensive industry that requires a strong reductant to reduce the iron ore in the Blast Furnace. CO obtained from the reaction of metallurgical coke with hot air is typically used for this purpose. Even though steel production is a highly integrated process that reuses its intermediate streams, significant amounts of CO (50-70%) end up in the Basic Oxygen Furnace Gas, with CO_2 (10-20%), H_2 (1-2%) and N_2 (15-30%), as an unusable gas mixture for their iron ore reduction step due to the oxidizing power of the present CO_2[1].

In the Laboratory for Chemical Technology, a Super-Dry Reforming technology has been developed to upgrade CO_2 and CH_4 mixtures to high purity CO and water[2] (schematics in Figure 1). Super-Dry Reforming is a chemical looping process, consisting of 2 cycles, 3 combined reactions and 3 solid materials (reforming catalyst, oxygen carrier and CO_2-sorbent) to maximize the CO yield. Overall, the process converts 3 molecules of CO_2 with 1 molecule of CH_4 to 4 molecules of CO and 2 molecules of H_2O. The CO from Super-Dry Reforming can be directly injected in a Blast Furnace, significantly reducing the carbon footprint of steel production, not only by reducing the amounts of CO_2 released to the atmosphere but also by reducing the amount of coke required in the Blast Furnace to produce the same amount of steel. Therefore, it is of interest to develop a process design based in process modeling and experimental results for its future implementation in the steel industry.

Program

- Literature review on chemical looping processes for dry reforming and CO_2 separation.
- Process simulation in Aspen Plus and Aspen Plus Dynamics.
- Experimental design for material testing in fixed bed reactors.

[1] Y. Kapelyushin, et al., 8th High Temperature Processing Symposium (2016), Melbourne.
[2] L. C. Buelens et al., *Science* **354**, pp. 449 (2016) DOI: 10.1126/science.aah7161