Reactive Gas Electrosorption (RGE): Electricity production/ CO_2 capture

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Motivation

With the continuous increase of CO_2 concentration in the atmosphere and the growing need of energy, the generation of clean energy is vital. In 2013, Hamelers et al. introduce a new technology capable of generating electricity from the mixing of CO_2 emissions and air in a capacitive cell[1] (figure 1). This technology has been named Reactive Gas Electrosorption (RGE).

Process

In RGE, a capacitive cell is composed of :

- Activated carbon electrodes (AC electrodes), which can stored ions and generate a flow of electrons
- Ions exchange membrane (IEM), which can generate a potential in contact with different ions concentration
- An electrolyte, needed to dissolve the CO_2 into ions. The ions concentrations depend then on the CO_2 gas pressure.

The RGE capacitive cell can be operated in two different modes.

Operated as a CAPMIX (capacitive mixing) process[2], the capacitive cell can generate an electrical current based on the mixing process between an exhaust gas from power plant (10-20% CO_2) and an air stream (0.04% CO_2) dissolved into an electrolyte. By harvesting energy from CO_2 emissions, the RGE technology could potentially increase the thermal power plant efficiency by 5%. In other words, more energy could be produced from power plants without consuming more fuel and emitting any extra exhaust gas.

Operated as a CDI (capacitive deionization) process[3], an external energy supply can drive the absorption/desorption of ions to/from the AC electrodes. Since the electrolyte ions concentrations influence the CO_2 dissolution, the charging/discharging of the capacitive cell can either capture or concentrate a CO_2 gas stream.

Technological challenge

The Reactive Gas electrosorption is a young concept. Moreover capacitve cell were first designed mainly for different purposes. Thus, the main objective is to get scientific insight of the RGE process and develop new designs specific for CO_2-electrolyte. The main priority is to develop a capacitive cell, capable of harvesting energy directly from a CO_2 gas.

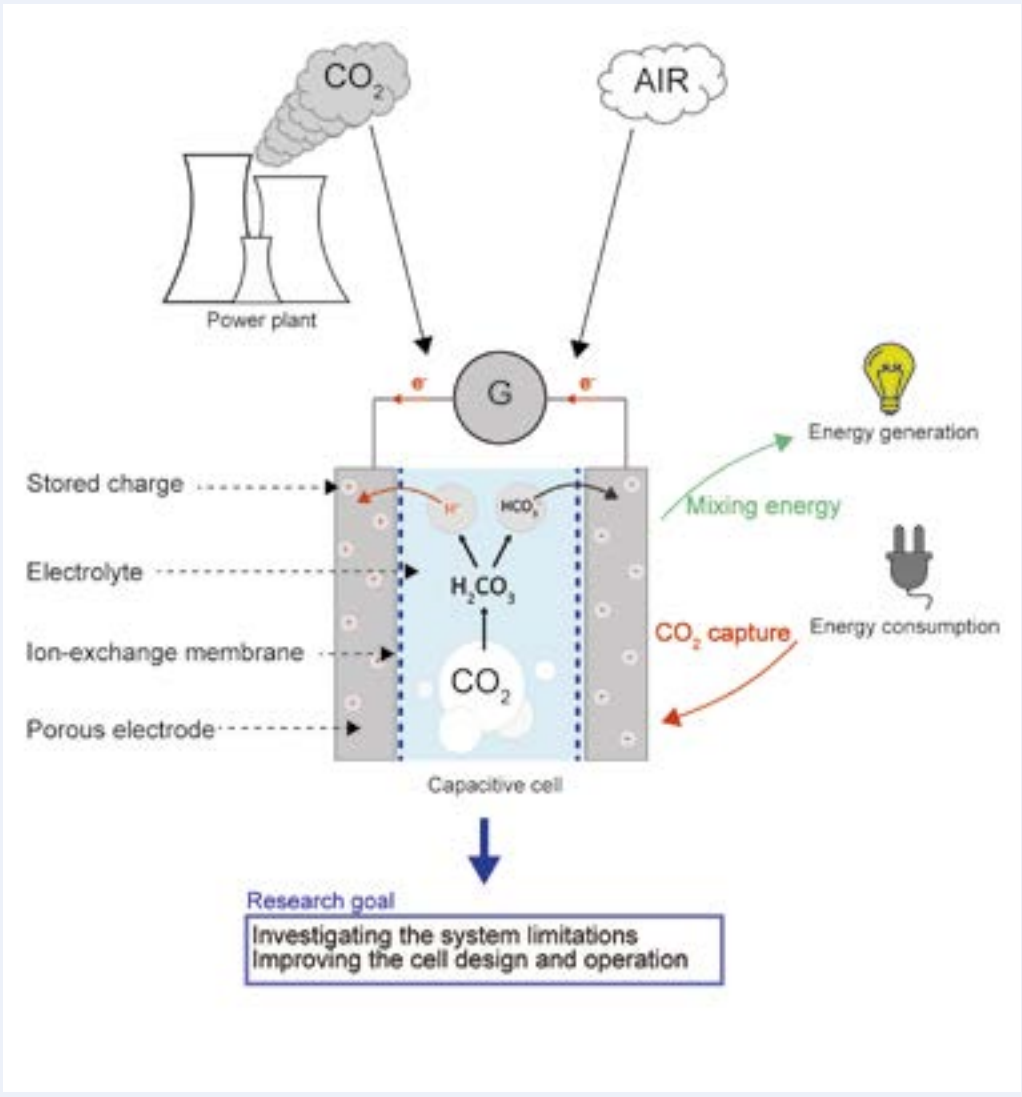

Figure 1. Graphical abstract of the project

Research objective

- Investigation of the major energy losses in the system
- Design of a direct gas capacitive cell
- Development of materials

References

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