Public summary of the project

Title: **Understanding of degradation phenomena of solid state oxygen carriers during cycling redox reactions through experimental investigation and development of strategies to eliminate the issue**

Acronym: **GEPARD**

For materials used for new emerging technologies e.g. energy storage and production, gas separation, it is important to understand their degradation mechanism. The materials mostly used in such technologies are metal oxides categorised into structures called spinel and perovskites. These structures are highly attractive because they have the ability to take up and release oxygen into different, referred to as redox properties. During these processes , not only oxygen ions move but also to some extent cations, leading to swelling of the structure, weakening of the material, and final collapsing. Stress and strain can also build up during redox, and consequently accelerate the degradation. It is therefore crucial to understanding the mechanism so that strategical adjustment of this material can be established to reduce the degradation related to redox processes. If mitigation strategies can be established on how to reduce or avoid degradation giving superior lifetime, this can pave the way for more sustainable technologies with reduced cost of maintenance.

Keeping in mind that power plants are major consumers of fossil fuels and one of the large contributors to greenhouse gasses concentration increase in the atmosphere, and perhaps to the global warming. One of the emerging technologies that can produce power and capture CO_2 at low cost is Chemical Looping Combustion (CLC), that has relatively high efficiency for power production and low cost for CO_2 capture.

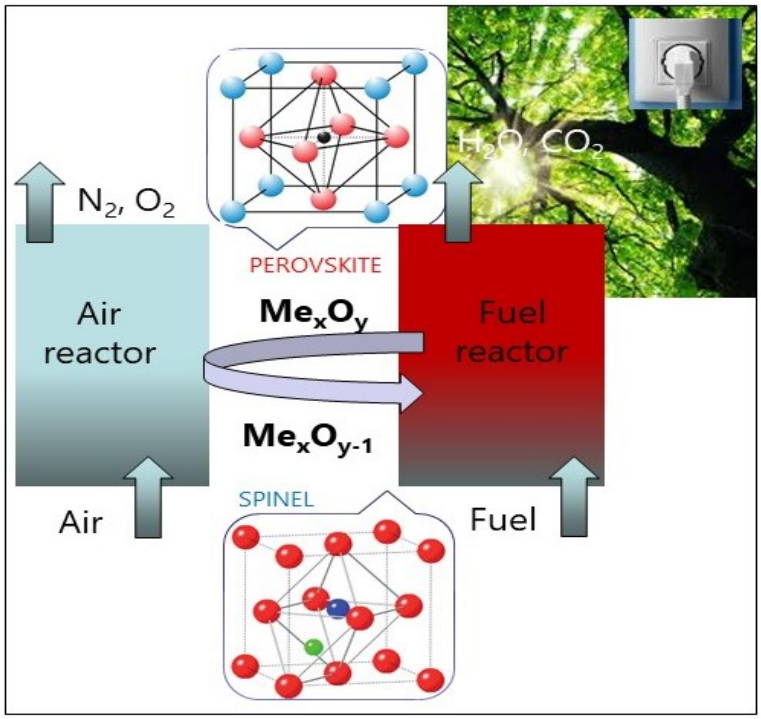

Figure (left) shows schematics of this project. In CLC a metal oxide is transported from the air reactor where oxygen is taken up by the oxygen carrier, to the fuel reactor where the oxygen is released. The challenge lies on how to obtain an oxygen carrier material that has the needed capacity for oxygen transport, high reactivity with fuel and air, hard to break in many working cycles, low cost and environmentally friendly.

GEPARD project will mainly focus on **two groups of oxygen carriers**. One is **spinel structure**, in which the cation has some mobility during redox, and the importance of maintaining structure during redox and restrict cation diffusion is of high importance. The other group is **perovskite** which is known for its high diffusion of oxide ions and relatively low diffusion of cations . But the challenge is mostly related to phase changes that lead to decomposition in the long run. In order to have a high structural stability, a moderate capacity is necessary to reduce stress during redox that can lead to cracking of particles in the long run.

GEPARD project aims to understand **the degradation phenomena of the oxygen carriers during cycling redox reactions "working duty" and to develop highly efficient, robust OCs for the CLC**, and verify their suitability for combustion of biomass and/or coal. The knowledge will also be beneficial for several emerging renewable and green technologies and the results will be published on peer-reviewed international journals. It is also expected to exchange knowledge on material science at PWr related to the CLC research field. Young scientists (PhD students at PWr) will be supported through international collaboration. The project is planned over a period of four years, and implemented by PWr (PL).