Transient CO$_2$ methanation over Rh/CeO$_2$-ZrO$_2$ catalysts

**Statement of the Problem:** The CO$_2$ valorization is one of the main research priorities worldwide. However, the CO$_2$ is a thermodynamically stable molecule that requires high-selectivity materials to react. Ceria-based catalysts have proved to be a suitable option for converting CO$_2$ into methane, especially the Rh/CeO$_2$. After applying a pretreatment of High Temperature Reduction (HTR) with pure H$_2$ to 1%Rh/CeO$_2$ materials, higher amounts of methane are produced during the transient state. That activity enhancement has been supposed to occur due to the additional oxygen vacancies (active sites) created after the HTR. The purpose of this study was to get new insights about the role of oxygen vacancies on the CO$_2$ activation, by testing materials with improved oxygen storage capacities.

**Methodology & Theoretical Orientation:** Polycrystalline CeO$_2$, CeO$_2$-ZrO$_2$ and ZrO$_2$ supports were synthesized by precipitation/co-precipitation method. 1% Rh was then loaded by incipient wetness impregnation. The samples were characterized by means of BET surface, XRD, TPR and TGA. The produced methane after both low and high temperature reduction was followed during 1 hour.

**Findings:** As the introduction of zirconium into the ceria lattice enhances the reduction degree of the materials, higher quantities of methane during the transient state are produced. Therefore, a relationship between the reduction degree of the CeO$_2$-containing materials and the CO$_2$ conversion was found. However, the additional oxygen vacancies formed during the treatment are not stable at reaction conditions. Further research is needed in order to understand the mechanism for which those high-activity sites could be kept.

**Recent Publications**


**Biography**

Monica Julieth Valencia Botero is a Project Researcher at the Vaasa Energy Business Innovation Centre (VEBIC) in the domain of the assessment of the energy systems, especially bioenergy and renewable energy. She has experience in several aspect of the energy business including technologies, environmental assessment, material science and biofuels and bioenergy. She has completed her Bachelor’s degree in Chemical Engineering and MSc in Engineering-Chemical Engineering at Universidad Nacional de Colombia-Manizales, Colombia and PhD in Environmental and Energy Engineering Sciences at the University of Udine, Italy.

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