Lanthanum-ceria modified with calcium for oxidative coupling of methane

Vivian Vazquez Thyssen[1], Vanessa Bezerra Vilela[1], Fábio Coral Fonseca[1]

[1]Instituto de Pesquisas Energéticas e Nucleares (*CECCO*)

e-mail: vivian_thyssen@outlook.com

Ethylene (C_2H_4) is considered a fundamental component of the chemical industry, it is a raw material widely used to produce plastics, solvents, fertilizers, etc. Currently, the main route to obtain $C_2H_4$is the steam cracking of naphtha from crude oil, a well-established technology that is hardly challenged. The search for more sustainable alternatives must be ongoing, and among the alternative, we can mention the use of natural gas. The oxidative coupling of methane (OCM), the main component of natural gas, is a compelling direct pathway of methane (CH_4) conversion into higher added value hydrocarbons, such as C_2($C_2H_6$and C_2H_4). [1] $La_2Ce_2O_7$catalyst performs well in OCM due to its high thermal stability, suitable alkaline sites, and selective mobile oxygen sites. Doping $La_2Ce_2O_7$with Ca increases the alkalinity, which can considerably increase C_2selectivity in the OCM. We have explored a scalable method of combustion synthesis, a high-throughput technique that provides favorable porous microstructures for stable catalysts at high temperatures. The obtained $La_2Ce_{2-x}Ca_xO_7$powders ($0 \leq x \leq 0.5$) SEM images evidenced a microstructure composed of porous sponge-like agglomerated particles with an irregular shape, expected from the type of synthesis. The materials showed crystalline structures of disordered fluorite and C-type, indicated by both XRD and Raman analysis. Raman spectroscopy data also evidenced the presence of surface oxygen vacancies on materials, which benefited the OCM reaction. The catalytic tests showed us that the addition of Ca increased the C_2selectivity by 10%, at 750^{o}C and a CH_4:O_2molar ratio of 6:1. [2]

Acknowledgments:

We are thankful for CINE-Shell/ANP-FAPESP''s financial support.

References:

[1] Thyssen, V.V. et al. Chem Rev 122, 3966 (2022).

[2] Vilela, V.B. et al. ECS Trans 103, 1917 (2021).