CO_2OLING THE EARTH
CO_2 Conversion Paths Explained Through EU Funded Projects
September 5-6, 2019
Amsterdam Science Park, Netherlands
www.co2olingearth.eu

Catalytic vs electrocatalytic reduction of CO_2 to added-value products.

Hilmar Guzmán[1,2], Fabio Salomone[1], Marco Fontana[2], Katarzyna Bejtka[2], Samir Bensaid[1], Nunzio Russo[1], Simelys Hernández[1,2]

[1] CREST group, Department of applied science and technology (DISAT), Politecnico di Torino, C.so Duca degli Abruzzi, 24, 10129, Turin, Italy

[2] Center for Sustainable Future Technologies, IIT@Polito, Istituto Italiano di Tecnologia, Via Livorno, 60, 10144, Turin, Italy.

Currently, around 85% of the energy matrix is dependent on fossil fuels. Burning fossil fuels provokes environmental pollutants such as CO_2, which is the most representative GHG and its concentration has increased in the atmosphere after industrial revolution to >410 ppm[1]. Therefore, to mitigate CO_2 emissions into the atmosphere, it can be exploited as a raw material to synthesize high added-value products (i.e. methanol) [2]. The electrochemical (EC) reduction of CO_2 is a sustainable and technologically interesting process to produce chemicals or fuels using renewable electricity sources[3]. The main challenge is to find a suitable electrocatalyst to establish this technology at an industrial level. In such context, our group have exploited, for this EC process, a Cu-based material typically used as catalyst in Thermochemical (TC) catalysis for the production of methanol. A commercial catalyst (Cu-Zn-Al-based) was tested for both processes for comparison. The TC CO_2 reduction reaction in H_2 atmosphere (25 bars and 250 °C) leads to a methanol selectivity of 50% and CO as side-product, whereas the EC process (at atmospheric conditions) yields different alcohols and other C-based products (C_1 to C_3) with an overall faradaic efficiency of ~70%. The EX situ X-ray diffraction pattern, Field-Emission Electron Microscopy and Transmission Electron Microcopy of the catalyst were compared before and after both experiments in order to study the role of the modification of the catalyst components during operation in the final selectivity. These results demonstrated that there is synergy between both processes that can be exploited to develop new electrocatalysts.

Acknowledgments

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement 768583– RECODE project.

Biography

Hilmar Guzmán has completed his master's degree and bachelor's degree at Politecnico di Torino (Italy), in the framework of a double degree between Politecnico di Torino (Italy) and Universidad Central de Venezuela (Venezuela). She is currently in the third year of her PhD course, which is focused in the conversion of CO_2 through an electrocatalytic route.

References

[1] Conti John, Holtberg Paul, Diefenderfer Jim, LaRose Agelina, Turnure James, W. Lynn, International Energy Outlook 2016.
[2] S. Hernández, M. Amin Farkhondehfal, F. Sastre, M. Makkee, G. Saracco, N. Russo, Syngas production from electrochemical reduction of CO_2: current status and prospective implementation, Green Chemistry, 19 (2017) 2326-2346.
[3] I. Ganesh, Conversion of carbon dioxide into methanol-a potential liquid fuel: Fundamental challenges and opportunities (a review), Renewable and Sustainable Energy Reviews, 31 (2014) 221-257.