Optimization of Cu-based catalyst for the electrocatalytic reduction of CO_2 to fuels

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In the last century, with the intensification of human industrial activities, carbon dioxide levels in the environment increased, making global warming and greenhouse effect pressing issues. In this sense, the electroreduction of CO_2 is an interesting strategy, also if coupled with renewable energy sources to store the intermittent electric energy in form of chemical bonds [1]. Catalysts composed of a mixture of commercial copper nanoparticles (NPs) were studied. NPs with particles sizes of 25nm, 40-60nm and ZnO: 20-25 nm, named CZ 25_B and CZ_40-60_B. The molar ratio between copper and ZnO is equal to 65/35. Another commercial catalyst that was analysed because it is active for the CO_2 hydrogenation is composed of $CuO/ZnO/Al_2O_3$ and traces of MgO (named CZA CC_B). These catalytic mixtures were prepared in a planetarian ball mill. Another sample was prepared by pre-oxidation of the Cu NPs and then by manual mixing with the ZnO (called CZ calc 2h). Carbon Nanotubes (CNT) was used as carbon substrate to increase the conductivity and allow a better catalytic ink dispersion. All the samples were characterized by BET analysis, FESEM microscopy, X-ray diffraction, X-ray photoelectron spectroscopy and electrochemical analysis. The electrocatalytic activity was tested by using a rotating disk electrode (RDE) at ambient conditions. The best conditions were appreciated at a potential equal to -2 V vs Ag/AgCl, with the lowest FE for H_2 and the highest current density (mA/cm^2) in absolute value. In Figure 1, the FE % of gaseous and liquid products are reported for the different prepared catalysts. From all test, the best catalytic activity with the lowest FE_{H2} was obtained with the Cu/ZnO peroxidised material (CZ calc 2h) at -2 V vs Ag/AgCl. In conclusion, it can be said that Cu-based catalysts were confirmed to be active towards CO_2RR via the electrochemical method, with the advantage of performing the reactions at ambient conditions.

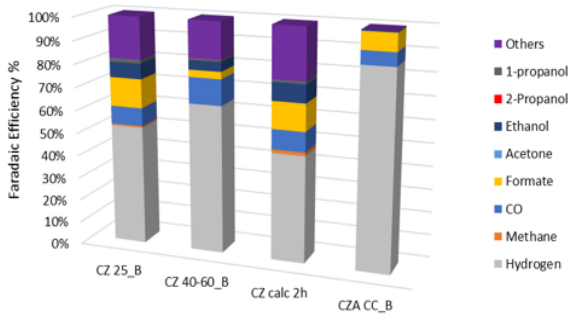

Figure 1: FE % of gaseous and liquid products for the different Cu -based catalysts

References

1. Hernandez, S., Farkhondehfal, M.A., Sastre, F., Makkee, M., Saracco, G., Russo, N. *Green Chemistry*. **2017**, 19, 2326 - 2346.