VIDEO ARTICLE

Vid. Proc. Adv. Mater., Volume 1, Article ID 200824 **(2020)**

Catalytic Materials in Green-Fuels Synthesis

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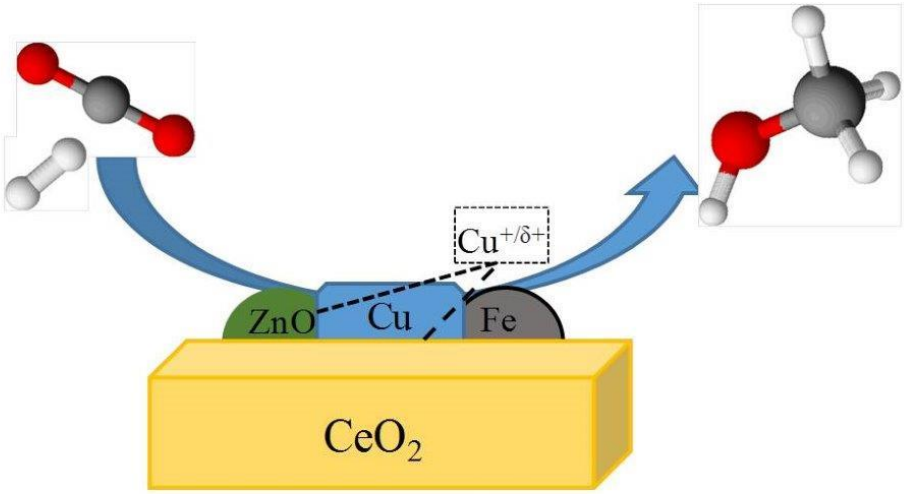
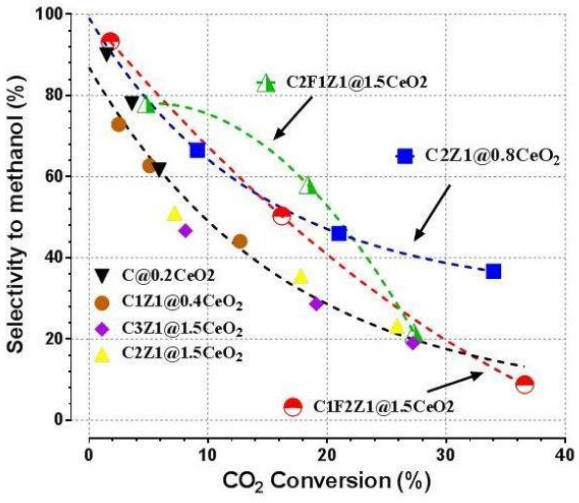
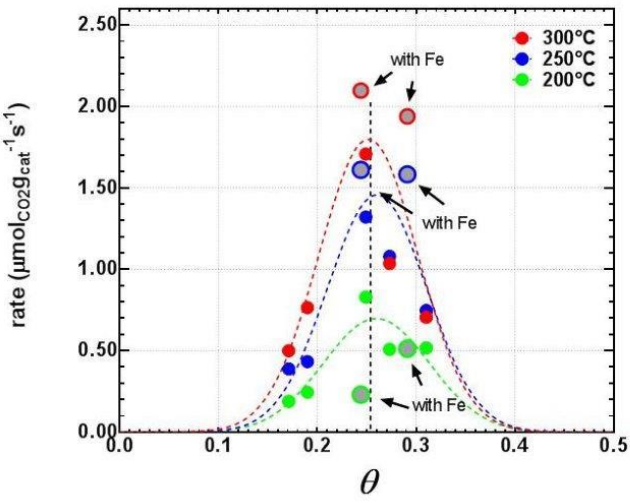
DOI: 10.5185/vpoam.2020.0824

Graphical Abstract







Abstract

Current prospective in the liquid fuels synthesis is prefiguring a greater integration of eco-friendly technologies based on the use of "non-fossil" hydrogen and CO_2. Differently from fossil fuels, the "total-green-fuel" does not give rise to extra CO_2 emission in atmosphere, because its combustion generates a CO_2 release equal to that necessary for its manufacturing. Although the efforts to limit its presence in the atmosphere (CCUS technologies), CO_2 it is assuming an even more important and strategic role in the energy field, as well as in the synthesis of industrial relevant products and chemicals. As proof, the most important industry companies, such as Haldor-Topsoe, are at the fore front in the use of CO_2 as carbon feedstock for power-to-gas technologies, while other international petrol industries, as the Italian ENI, are redesigning the lines of production in a "greener" vision, by the development of new hydrogenation processes, such as ENI Ecofining^{TM}, for the green-fuels synthesis, strategically prefiguring the production of ultra-pure CO_2 as industrial practice. In this scenario, the development of more efficient catalytic materials for an effective hydrogenation of CO_2 appears of great interest. Therefore, the activity and selectivity pathways of $MOx@CeO_2$ (i.e. M=Cu, Fe and Zn) catalytic materials have been assessed in the CO_2 hydrogenation reactions, going insight on reaction mechanism and shedding light on the structure-activity relationships. In particular, a higher copper content leads to the sintering of the catalytic surface, affecting catalyst morphology and activity, although, the partial replacement of cerium with iron seems to slightly favour the exposure of the metallic surface area of copper, resulting almost unchanged the total surface area of catalyst. The catalytic findings point to the synergic catalytic action of copper-to-zinc and copper-to-cerium, reflecting structural and electronic effects, driving to a favourable $Cu°/Cu^{+}$ ratio and stabilizing Cu^{+} sites when Cu^{0}-O-Cu^{+1} species across CeO_2 interface.

Keywords: Advanced catalytic materials, CO_2-to-fuels, renewable energy.

Acknowledgements

We thank EURECAT R&D division, site of the Gela ENI refinery, for support.

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Lorenzo Spadaro, PhD, ScD, Industrial Chemist and Process Engineer, Senior Researcher of the Italian National Research Council and Qualified Professor of Industrial Chemistry. Researcher in chief of project “Design of Advanced Catalytic Materials and Processes Engineering for Energetic and Environmental Industrial Applications”. Professor of the Doctoral School in "Materials for Health, Environment and Energy", University of Rome "Tor Vergata".

Citation of Video Article

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