Evaluation of bifunctional CeO_2/ZrO_2 catalysts in methane electrooxidation

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Methane (CH_4) is the main component of natural gas (70 to 90%), the fossil fuel, whose consumption has grown the most in the world. The International Energy Outlook 2019 projects that global consumption of natural gas will increase by 40% from 2018 to 2050, reaching 200 quadrillion btu [1]. Electro-oxidation of this compound can occur at low temperatures *via* direct method and the increase in the conversion rate to methanol can be achieved with the development of new efficient catalysts. In this work, the synthesis of CeO_2/ZrO_2-based bifunctional electrocatalysts was evaluated using the hydrothermal process assisted by microwave, varying the proportions in the ratios of 1:2, 2:1 and 1:6 Ce/Zr, respectively. Such mixtures are used as starting precursors to form mixed metal oxides and solid solutions followed of heat treatment at 200ºC for 30 minutes for phase formation, called mixed oxides ($Ce_xZr_yO_2$) and solid solutions (CeO_2/ZrO_2). The electro-oxidation of methane under potentials of 1.1V and 1.6V vs. Ag/AgCl led to the majority formation of methanol, ethanol, and acetone as the main products of this conversion in sodium carbonate medium as an electrolyte. However, these conversions are more pronounced from the variation of Ce/Zr ratios to produce both alcohols with 2.4% and 4.2% efficiency for CeO_2/ZrO_2(1:1), respectively, while CeO_2/ZrO_2(1:2) generates only methanol with a higher efficiency of 6.9%. Thus, under optimized conditions, it was possible to observe that ceria and zirconia oxides can efficiently promote the conversion of methane to other commercially valuable products using suitable oxidation potentials and, therefore, be a promising alternative for this reaction.

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