ABSTRACT

Life on Earth, as we know it, is threatened by climate changes – global warming – mainly caused by greenhouse gases. Combustion of large amounts of fossil fuels is intrinsically related to the emission of greenhouse gases, such as carbon dioxide (CO_2). Thus, it is essential to either reduce emissions or to collect these gases and give them practical applications. Consequently, this work focuses on the photoelectrochemical (PEC) reduction of CO_2 into fuel or the generation of green fuel – hydrogen – from aqueous solutions.

This research included the preparation and characterization of thin layers of Cu_xO and TiO_2 on the surface of foils and porous matrixes made of Cu or Ti. Additionally, a series of perovskite- or delafossite-type compounds (AB_xO_y and AB_xS_y) were synthetized to modify the surface of the thin layers by two methods: spin coating and spraying. The obtained composites were evaluated in the PEC conversion of CO_2 and/or H_2 generation and/or pollutant degradation. Furthermore, mechanisms of the reactions were proposed based on physicochemical and electrochemical characterization.

Optimization throughout series of composites was performed to identify a stable construct which proved effective in the PEC CO_2 reduction into methanol under visible light. The composite consisted in $CuFeO_2$ sprayed onto Cu_xO/Cu, with a Cu porous sponge as matrix. The specificity of the reaction was confirmed with isotopically labeled carbon dioxide, $^{13}CO_2$, what confirmed the carbon source in the produced methanol.