Title: Solar-promoted photo-thermal CO2 methanation on SiC/hydrotalcites materials

Abstract: The photothermo-catalysis is a combined multicatalytic approach that allows to overcome some drawbacks of the respective single catalytic processes as the thermocatalysis and the photocatalysis. In this work, to efficiently exploit the potentiality of the solar photothermo-catalysis, SiC/hydrotalcites-derived catalysts were prepared with a simple hydrothermal method to exploit both the thermocatalytic properties of the formed multifunctional mixed oxides and the photo(thermo)-catalytic features of the silicon carbide. Two different hydrotalcite-derived catalysts were prepared, one with Mg-Co ions and another with Zn-Co ions. This latter sample, after the addition of SiC, showed the best performance in the CO2 methanation reaction, with a CH4 selectivity maximum of 71% in the photothermal conditions at 250°C, strongly improving the performance of the thermocatalysis (36% at 350°C). The presence of SiC permitted to increase the solar light, to affect the basic sites of the hydrotalcite-derived catalysts, allowing to further promote the CO2 activation, and to generate self-heating effects that enhanced the photo-driven thermocatalytic effects. Furthermore, the formation of photocatalytic active species as the ZnO and the ZnAl2O4 after the calcination of the corresponding hydrotalcite precursor, led to exploit additional photocatalytic contributions to further increase the catalytic activity in the photo-promoted CO2 conversion into methane. The high versatility and the several synergisms generated by the application of this hybrid catalysis with these peculiar Si-C/hydrotalcite derived catalysts can be a sustainable strategy to efficiently valorise the carbon dioxide.