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Brookite TiO_2-CeO_2 composites for the VOCs oxidation and the subsequent CO_2 conversion into solar fuels

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Nowadays, high quality clean air for both indoor and outdoor environments is strongly recommended. The solar total photocatalytic oxidation of volatile organic compounds (VOCs) to water and CO_2 can be considered a suitable solution for a sustainable air purification [1]. CO_2 is considered the main greenhouse gas. Therefore, it is essential the development of new strategies that can mitigate the environmental impact of CO_2. In this contest, a hybrid catalytic approach, as the photothermo-catalysis, can be a fascinating route to obtain a high VOCs conversion at lower temperatures compared to the thermocatalytic combustion, with the possibility to further convert the produced CO_2 into value-added fuels (as CO, CH_4, CH_3OH, etc.) through the simultaneous action of heating and solar photoexcitation [2]. For this purpose, versatile (photo)catalysts are required, as mixed oxides able to show thermo and photo activities. In this work, we have synthesized brookite TiO_2-CeO_2 composites, to pair the photocatalytic features of the least common polymorph of TiO_2, with the thermocatalytic redox ones of CeO_2. The performance of the TiO_2-CeO_2 composite were evaluated in the photothermo combined approach, i.e. the toluene (model VOC) oxidation and the subsequent CO_2 conversion (**Fig. 1**)

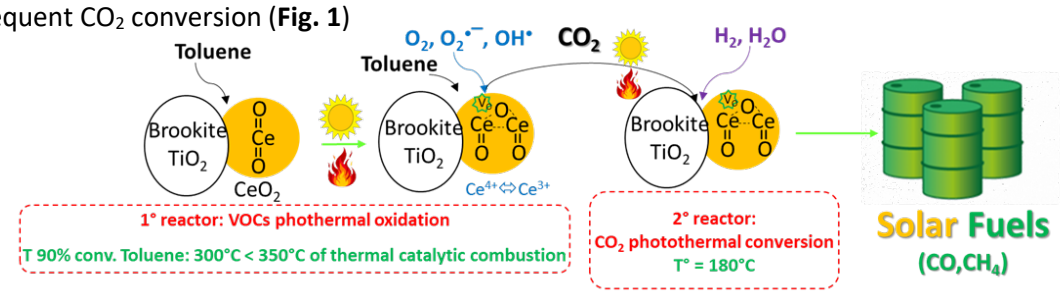

Fig. 1 *VOCs removal and the following CO_2 conversion. Vo represents an oxygen vacancy.*

The characterization techniques pointed to the formation of an efficient heterojunction between TiO_2 and CeO_2, with a strong electronic interaction between the two oxides, facilitated by the peculiar features of brookite phase that favoured the formation of oxygen vacancies, boosting the redox properties of CeO_2, thus providing beneficial effects in both the reactions. This multi catalytic approach can be an effective strategy to obtain solar fuels starting from dangerous pollutants with a fascinating *VOCs to fuels* pathway.

References:

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