Cork-derived ceria ecoceramics for solar fuel production via thermochemical redox process using concentrated solar energy

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This study deals with the thermochemical solar CO_2 splitting using cork-templated CeO_2 ecoceramics. Cork granules were heated in nitrogen at 900 ºC to produce a carbon skeleton, which was then infiltrated with cerium nitrate solution, dried, and heated in air at 1600 ºC to form a highly porous pure cork-templated ceria [1,2]. These ceria granules were then tested for CO production from CO_2 splitting via two-step redox cycling under controlled atmospheres using a solar chemical reactor mounted on a medium size solar furnace facility at CNRS-PROMES by means of concentrated solar heating. For comparison, ceria foams produced from polyurethane templates were also investigated [3]. Results have shown that the CO production yields for cork-derived ceria were two times higher than those observed for the polymeric templated ceria, suggesting that the three-dimensionally ordered macroporous ceria enhanced the reaction rates. The material's stability was demonstrated by performing 11 cycles (reduction in Ar at ~1400 ºC followed by oxidation in CO_2 at ~1000 ºC). The maximum peak specific CO release rate achieved with the cork-templated CeO_2 (1.43 µmol s^{-1} g^{-1}) was roughly three times greater than that previously reported for ceria reticulated porous foam with dual-scale porosity (0.56 µmol $_{CO}$ s^{-1} g^{-1} $_{CeO2}$).

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