Tuning of Defects and Disorder in Lanthanum-doped Ceria Nanoparticles for Oxidative Coupling of Methane

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The instability of petroleum prices and the advancements in extraction technologies of natural gas has increased the interest in the direct conversion of methane to C_2products via oxidative coupling of methane (OCM) reactions. The design of catalysts by tailoring the structural defects and disorder has a significant impact on their performance [1]. Within this context, in this work, the fine-tuning of oxygen defects in rod-like NPs was performed via La^{3+}doping ($La_xCe_{1-x}O_{2-1/2}$), *x*, in the 10-70 mol% range. The NPs characterization was performed by SEM, HRTEM, XRD, BET and Raman spectroscopy, and the OCM catalytic performance was evaluated at 750 °C. The relative concentration of reagents ($CH_4$and O_2) and products H_2, CO, CO_2, C_2H_4, and $C_2H_6$was measured by an online mass spectrometer. XRD and Raman analysis revealed that the CeO_2fluorite crystalline structure is essentially maintained in the doped nanorods, even for x= 0.7. The Raman spectra analysis indicates that La doping result in the formation of extrinsic and intrinsic oxygen defects that increase with increasing La concentration. The $La_xCe_{1-x}O_{2-1/2}$ catalysts showed good performance for OCM with methane conversion up to 32% and C_2selectivity up to 44% for x=0.5. In addition, all catalysts showed high stability within 20h time on stream. The demonstrated structural defect control on La-doped CeO_2NPs provide important insights to improve the performance of OCM reaction.

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References

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