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Oxygen Storage Behavior of Nanoparticulated Pr1-xZrxO2-δ

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Abstract

Pr1-xZrxO2-δ (x=0, 0.2, 0.4, 0.6, 0.7, 0.8, 0.9 and 1) nanoparticles were synthesized by ultra-sound assisted coprecipitation. The crystalline structure, morphology and composition of the fresh prepared and thermally aged nanoparticles were analyzed by XRD, TEM and Raman spectroscopy. The oxygen storage capability (OSC) and thermal durability were examined by temperature programmed reduction (TPR). The oxygen storage and transport mechanism were evaluated using electrochemical impedance spectroscopy (EIS) by correlating electrical conductance with lattice defects. The results indicate that Pr1-xZrxO2-δ nanocrystallized particles exhibit fluorite structured except ZrO2 nanoparticles with a typical tetragonal structure. The oxygen storage and release capability of both fresh prepared and thermally aged Pr1-xZrxO2-δ increases monotonously with increment of Pr concentration (or decrease in Zr) to a maximum value of 1200 [μmol/g] that corresponds to PrO1.833 (Pr6O11), indicating their superior OSC and thermal durability. Unlike conventional Ce1-xZrxO2-δ promoters, the oxygen storage, release and transport of Pr1-xZrxO2-δ nanocrylline solid solutions accompanies with a homologous series of phase transformations by the change in lattice defects of oxygen interstitials, electron holes and Pr3+ cations. Compared to Ce1-xZrxO2-δ, Pr1-xZrxO2-δ presents better OSC (x≤0.4), thermal durability and a different mechanism on oxygen storage and transportation. This study manifests that Pr1-xZrxO2-δ (x≤0.4) solid solutions can be used as better promoters for the three way catalysts (TWC) in lieu of Ce1-xZrxO2-δ.

Biography:

Mr. Jianqi Zhang has completed his PhD at the age of 36 years from the University of Central Florida. He continued postdoctoral studies at Massachusetts Institute of Technology. He currently serves as a Professor and the Director of Foreign Affairs at Inner Mongolia University of Science and Technology, China. He has published more than 80 papers in reputed journals and 4 books.

Speaker Publications:

1. "Electrochemical behaviour of rare earth based aluminium alloys"; Asian J. Chem. / 2013 / 30(8) /pp 1731-1735.
2. "Crystallization, mechanical and electrochemical behavior of Al-Ce-TM (TM = Fe, Co, Ni and Cu) amorphous alloys"; Int J Nanotechnol Nanomed/ 2019/ 4(3).
3. "Glass-forming ability, thermal stability, mechanical and electrochemical behavior of Al-Ce-TM (TM = Ti, Cr, Mn, Fe, Co, Ni and Cu) amorphous alloys"; Journal of Non-Crystalline Solids: X/ 2020, 100005.

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