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Mechanosynthesis and structural characterization of nanocrystalline $\text{Ce}_{1-x}\text{Y}_x\text{O}_{2-\delta}$ ($x = 0.1 - 0.35$) solid solutions

Martin Fabián^{a,b,*}, Bratislav Antić^c, Vladimír Girman^d, Milica Vučinić-Vasić^e, Aleksandar Kremenović^f, Shigeru Suzuki^g, Horst Hahn^a and Vladimír Šepelák^{a,b}

^aInstitute of Nanotechnology, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

^bInstitute of Geotechnics, Slovak Academy of Sciences, Watsonova 45, 04001 Košice, Slovakia

^c“Vinča” Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia

^dInstitute of Physics, P. J. Šafárik University, Park Angelinum 9, 04154 Košice, Slovakia

^eFaculty of Technical Sciences, University of Novi Sad, Trg D. Obradovića 6, 21000 Novi Sad, Serbia

^fLaboratory of Crystallography, Faculty of Mining and Geology, University of Belgrade, Djusina 7, 11001 Belgrade, Serbia

^gInstitute of Multidisciplinary Research for Advanced Materials, Tohoku University, Katahira 2-1-1, Aoba-ku, 980-8577 Sendai, Japan

Abstract

A series of nanostructured fluorite-type $\text{Ce}_{1-x}\text{Y}_x\text{O}_{2-\delta}$ ($0 \leq x \leq 0.35$) solid solutions, prepared via high-energy milling of the $\text{CeO}_2/\text{Y}_2\text{O}_3$ mixtures, are investigated by XRD, HR-TEM, EDS and Raman spectroscopy. For the first time, complementary information on both the long-range and short-range structural features of mechanosynthesized $\text{Ce}_{1-x}\text{Y}_x\text{O}_{2-\delta}$, obtained by Rietveld analysis of XRD data and Raman spectroscopy, is provided. The lattice parameters of the as-prepared solid solutions decrease with increasing yttrium content. Rietveld refinements of the XRD data reveal increase in microstrains in the host ceria lattice as a consequence of yttrium incorporation. Raman spectra are directly affected by the presence of oxygen vacancies; their existence is evidenced by the presence of vibration modes at ~ 560 and $\sim 600 \text{ cm}^{-1}$. The detailed spectroscopic investigations enable us to separate extrinsic and intrinsic origin of oxygen vacancies. It is demonstrated that mechanosynthesis

* Corresponding author. Tel.: +421-55-7922608; Fax: +421-55-7922604; E-mail: fabianm@saske.sk.

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