

SAIP 2011



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Effect of annealing on the Ce³⁺/Ce⁴⁺ ratio measured by XPS in luminescent SiO₂:Ce

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Content :

Ce doped silica has potential applications for a luminescent material as phosphors for cathodoluminescence, scintillators and detectors. Ce ions can occur in a trivalent or a tetravalent state: only the trivalent Ce³⁺ state with a single 4f electron is optically active, while the tetravalent Ce⁴⁺ ion is non-luminescent. X-ray photoelectron spectroscopy (XPS) is a suitable technique to investigate the oxidation states of Ce in cerium oxides and such studies have been carried out because of the importance of CeO₂/Ce₂O₃ conversion in automotive exhaust catalysts. However, the XPS Ce(3d) spectrum of cerium oxide is rather complex as it contains ten closely spaced and overlapping peaks on a strong background. The main challenge is to obtain accurate fits to experimental data while still maintaining a good physical basis for the fitting parameters. The analysis of Ce in SiO₂:Ce is even more challenging since the Ce concentration for luminescent samples is only in the region of 1%. Although it has been experimentally shown that to improve the luminescence efficiency of Ce doped silica it can be useful to anneal the glass in a reducing atmosphere, with the implication that this increases the concentration of Ce³⁺ luminescent ions, we are not aware of XPS measurements that correlate the relative concentrations of the Ce³⁺ and Ce⁴⁺ ions to the luminescent properties. In this work, cerium doped silica was prepared by the sol-gel method. The effect of annealing temperature and atmosphere on the luminescent properties are correlated to XPS measurements of the oxidation state of Ce in the samples.

Level (Hons, MSc, PhD, other)? :

PhD

Consider for a student award (Yes / No)? :

yes

Short Paper :

yes

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