

CERIUM-ACTIVATED SILICA GEL-GLASSES FOR USING IN SCINTILLATORS

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Ce-containing glasses are of interest as ionizing radiation detectors materials with increased radiation optical stability as well as light filters absorbing UV-radiation [1].

The cerium-activated silica glasses were prepared by modified sol-gel process. The source materials were tetraethylorthosilicate $\text{Si}(\text{OC}_2\text{H}_5)_4$, hydrochloric acid (as a catalyst), aerosil (finely dispersed powder SiO_2), cerium chloride and distilled water. The purities of the reagents were similar to those of analytically pure reagents. The process of synthesis incorporates tetraethylorthosilicate hydrolysis in water solution of the acid to obtain a sol, preparation of the colloid by adding aerosil into the sol, the addition into the sol-colloid system of cerium chloride, the neutralization of the activated sol-colloid system up to pH ≈ 6.5 by introducing an ammonia solution, liquid slip casting, gel-formation, drying and vitrification under equal temperature-time conditions of monolithic xerogels to a state of transparent glass, and inertial cooling. In parallel, samples were synthesized whose activation was carried out by impregnating the xerogels obtained with a water and a water-alcohol (2:8) solution of cerium chloride. The redox conditions of vitrification were varied by carrying out this process in air or in vacuum.

A spectral-luminescent study of Ce-containing silica gel-glasses doped at the sol stage and by impregnating porous xerogels with activator chloride salt solutions has been performed. The influence of the degree of doping and redox conditions of vitrification on the activator charge state and the content of hydroxyl ions and chlorine in the glass is considered. The preservation of the glass phase composition and the non-linear increase in the visible absorption intensity with increasing activator concentration from 5×10^{17} to 3.0×10^{20} ions/cm³ are noted. It is concluded that there are two main types of optical centres. It is assumed that they represent Ce(III) oxygen complexes whose nearest surrounding includes quadruply-charged (the first type) and triply-charged (the second type) ions of cerium [2].

The scintillation efficiency of sol-gel silica glasses doped with cerium ions are discussed.

1. A.Sivade, G.Orcel, L.L.Hench et. al., J. of Non-Cryst. Sol., 1998, v.105., p.232-242
2. G.E.Malashkevich, E.N.Poddenezhny, I.M.Melnichenko et. al., J. of Non-Cryst. Sol., 1995, v.188, p.107-117.