Neodymium Doped Luminescent Composites Derived from the Sols Based on Carboxylic Acids

M. V. Rudenko, A. V. Mudryi, T. I. Orekhovskaya, and N. V. Gaponenko

Abstract Luminescent structures presented monocrystalline silicon and porous anodic alumina with neodymium doped yttrium alumina composites YAC:Nd that were formed by sol-gel route from different sols. Structure, phase composition and luminescence of the obtained structures were investigated. Photoluminescence spectra of structures containing YAC:Nd carry emission bands caused by electron transitions of neodymium. Thin emission bands structure of all samples occurs due to Stark effect appearance.

Keywords Luminescence · Yttrium alumina composites · Sol-gel · Neodimium

Yttrium aluminum garnets and perovskites doped with lanthanides are widely used as active components of solid-state lasers, X-ray scintillators, light emitting phosphors in liquid crystal displays and cathode luminescence devices. One of the most promising methods of obtaining YAC is sol-gel method. Various precursors and approaches to the synthesis of the amorphous phase make it possible to influence the crystallization temperature, the final size of the crystallites, dispersion, purity and other material properties [1]. The use of carboxylic acids is rather promising.

In this work we used the nitric acid salts of yttrium and neodymium, aluminum isopropoxide, lactic and citric acids and butyl alcohol as solvents. Xerogels were synthesized on silicon substrates and structures of porous anodic alumina (PAA) formed on silicon after annealing at 1000 °C.

The X-ray diffraction spectrum of the xerogel powder obtained from the citric acid sol contains diffraction lines corresponding to the cubic crystalline $Y_3Al_5O_{12}$ (PDF-82-0575). The same weak diffraction lines are resolved for the xerogel films

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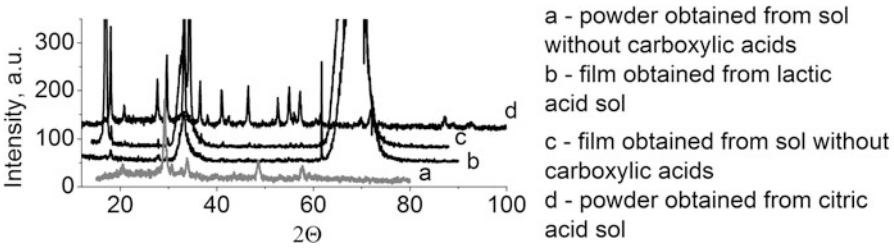

Fig. 1 X-ray diffraction patterns of neodymium-doped YAC obtained from different sols

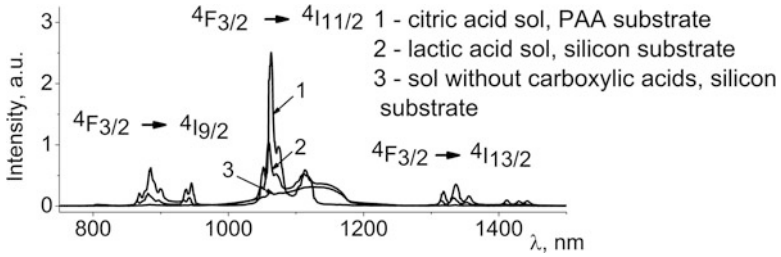

Fig. 2 The luminescence spectra of neodymium-doped YAC xerogels obtained from different sols. Excitation wavelength is 325 nm

formed on monocrystalline silicon. The average crystal powder size of the xerogel powders synthesized from citric acid and lactic acid sols were 25 and 9.5 nm, respectively (Fig. 1).

The samples reveal strong room temperature photoluminescence with the characteristic Stark splitting of the luminescence bands of trivalent neodymium ions [2] presented on Fig. 2. Spectra of xerogels formed on monocrystalline silicon also contain luminescence band of silicon, which slows down when using the lactic acid sols.

The sol-gel derived YAC powders are presently more developed than thin films, although the last have also found practical application [3]. The use of lactic acid in the sol composition allows the reduction of side phases formation of YAG xerogel thin films on monocrystalline silicon and generation of highly dispersed YAC powders.

References

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