Photoluminescence characteristics of Y_2O_3: Er^{+3},Li^+ thin films deposited by spray pyrolysis.

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Yttrium oxide (Y_2O_3) films have received considerable attention over the years as rare earth host matrix for applications in planar optical amplifiers, and in general as photoluminescent and cathodoluminescent phosphors; mainly, due to its low absorption in the range of 0.2-8 μm, high refractive index (1.9) and low phonon energy (380 cm^{-1}), regarding the issue of film versus powder phosphors, phosphor films show some advantages respect to powder phosphors such as a better thermal stability, better adhesion, and improved uniformity over a substrate surfaces. However, the main problem of the phosphor films in comparison with bulk powders is their low brightness. Addition of Lithium (Li^+) in small amounts is known to play an important role in enhancing the luminescence efficiency of phosphors. In this work report the improvement of the luminescent emission of Y_2O_3: Er^{+3},Li^+ thin films deposited by ultrasonic spray pyrolysis.

The films were deposited using a 0.03 M of yttrium acetylacetonate (Y(acac)) hydrate ($YC_{15}H_{21}O_6.XH_2O$) dissolved in N,N-dymethilformamide. The doping of the films with Er was achieved by adding Erbium (III) acetate (Er(Ac)) hydrate ($(CH_3CO_2)_3Er.XH_2O$) in the solution at 1.5% in relation to the Y content. The co-doping with Li was achieved adding Lithium acetylacetonate ($CH_3COCH=C(OLi)CH_3$) (Li(acac)). the Li contents studied were 0, 0.5, 1, 2, 3, 3.5 and 4 at % in relation to the Y content. The deposition temperature was 500ºC.

The characteristic Er^{+3} related emission spectra showed an intensity increase by a factor of ~4-5 times with the addition of 2% of Li^+. This behavior is attributed to the distortion of the local crystalline field induced by the incorporation of Li^+. The films were deposited at 500°C by ultrasonic spray pyrolysis technique on (100) silicon wafers. The films were the polycrystalline with a pure Y_2O_3 cubic phase. The addition of Li^+ reduces the intensity of the diffraction peaks after 1%, and shifts the main diffraction peak towards large angles for Li^+ doping less than 3 %.

It should be pointed out that the films did not receive thermal annealing after they were deposited and the photoluminescent measurements were carried out at room temperature.