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Effect of deposition conditions on the characteristics of the thin films obtained by using Pulsed Laser Deposition

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poster

Summary

There has been extensive research on how the deposition conditions parameters (substrate temperature, background pressure, laser energy, laser fluency, laser repetition rate/number of pulses etc.) affect the characteristics (such as crystal structure and surface morphology) of the films grown. However the influence of deposition conditions on luminescence properties of films has not yet been extensively studied because it is a secondary effect and results mainly because of the change in crystal structure and the surface morphology of the films. This paper presents the effect of substrate temperature and oxygen partial pressure on the crystal structure, surface morphology and the luminescence characteristics of the $\text{Gd}_2\text{O}_2\text{S:Tb}^{3+}$ thin films grown using PLD. It was observed that oxygen pressure affects the structural properties of the $\text{Gd}_2\text{O}_2\text{S:Tb}^{3+}$ thin film and high quality layers can only be prepared in the narrow range of oxygen pressure between 100 and 200 mTorr. The oxygen pressure has a major effect on the film morphology. The films deposited at 100mTorr are very smooth and dense. The films deposited at 300mTorr are very rough with numerous cracks on their surface and display a porosity. These differences in film morphology is explained by the decrease of the kinetic energy of the deposited species with increasing oxygen pressure. Thin film deposited at 100 mTorr was found to be the best in terms of the PL intensity of the $\text{Gd}_2\text{O}_2\text{S:Tb}^{3+}$ emission, and thereafter the PL intensity decreased dramatically as the oxygen partial pressure increased. The main emission peak due to the $5\text{D}_4\text{-}7\text{F}_5$ transition is at a wavelength of 545 nm. The PL of the films grown at a higher substrate temperature was generally also more intense than those that were grown at a lower substrate temperature.

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