Optical Studies on Flash Lamp Annealed Doped and Undoped β-Ga_2O_3 Thin Films Prepared by Spray Pyrolysis

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With its wide band gap of around 4.9 eV, β-Ga_2O_3 is a promising transparent semiconductor for (opto-) electronic applications. Besides the established techniques for the preparation of β-Ga_2O_3 layers, for instance chemical vapor deposition, electron beam deposition, molecular beam epitaxy, and pulsed laser deposition, low cost techniques such as ultrasonic nebulization and spray pyrolysis are also of great interest. With the latter we prepared β-Ga_2O_3 thin films on silicon substrates.

For the preparation of β-Ga_2O_3 a solution of $Ga(NO_3)_3$ in water or in a water/ethanol mixture was employed. Rare earth elements, like Er^{3+}, Sm^{3+}, and Gd^{3+}, and Al and Mg were used as dopants. The β-Ga_2O_3 thin films were investigated by scanning electronic microscopy (SEM), X-ray diffraction, Raman spectroscopy, as well as imaging and spectroscopic ellipsometry.

Since Gallium oxide, like we prepare it, needs a high annealing temperature to form the β-modification (higher than 800 °C), we use flash lamp for the annealing. There for we use energies from 10 J/cm² to 60 J/cm² and apply some additional heat with a heat plate (room temperature to 600 °C). With this we want to prepare the thin films for the application in (opto-)electronic devices.

In this work we compare by using optical investigations the characteristics of β-Ga_2O_3 thin films, which had been flash annealed and thermal annealed.