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Correlation between crystallographic localization of Erbium in RF magnetron sputtered AlN:Er by laboratory XRD and CTEM with luminescence quenchingValerie BRIEN¹, Pascal Boulet²¹CNRS Institut Jean Lamour, Vandoeuvre lès Nancy, France ²IJL (CC X-gamma)
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Rare earths (RE) are naturally not luminescent materials, however when adequately placed in specific matrices they can become optically active and lead to photo luminescent or electro luminescent phenomena. The associated modification of quantic selection rules is intimately related to the neighbourhood of the active centres. So, knowing where the optical centres are in the material is a key issue to progress in the understanding of their physical mechanisms. Nitrides (gallium, indium or aluminium based) doped with RE are known to exhibit a so called "concentration quenching" translating a saturation effect that is often mentioned to be due to precipitation of RE rich phases when increasing the doping of the luminescent element. The authors have used TEM and XRD to study the AlN system prepared by reactive magnetron R.F. sputtering on a doping range of Erbium from 0 to 6 atomic %. One will present the analysis of the data and stress on the specific XRD detexturation procedure achieved by the authors on the films. One will show that this process allows AlN:Er_x to be a solid solution even when x reaches 6 atomic %. One will also present the analysis of the XRD measurements thanks to intensity calculations based on atomic models confirming that the main location of Erbium in the AlN würtzite is the metal substitution site on the whole range. Results also authorize to think that both octahedral and tetrahedral sites of the würtzite do welcome Er ions over the [1.6 – 6 %] range. Finally, the localization of the atoms will be confronted to the diverse interpretations of literature concerning the concentration quenching luminescence, for instance to the model published by Benz [1].

[1] F. Benz, A. Gonser, R. Völker, T. Walther, J.-T. Mosebach, B. Schwanda, N. Mayer, G. Richter, H.P. Strunk, J. Lumin. 145 (2014) 855–858

Keywords

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