CATHODOLUMINESCENCE IN NEW GENERATION NITRIDE COMPOUNDS

Gabija Soltanaitė[1], Žydrūnas Podlipskas[1], Viktorija Mickūnaitė[1]

[1]Vilnius university
gabija.soltanaite@ff.stud.vu.lt

The possibility to modify AlN and AlScN properties such as piezoelectricity and mechanical stability to meet the needs of contemporary devices encourages the investigation of new generation nitride derivatives and the optimization of their composition. This scientific work is dedicated to studying cathodoluminescence of new generation nitride compounds – a series of AlScN samples containing scandium concentrations from 14% up to 41%, including a sample of AlN.

As the amount of scandium atoms in the material increases, so does the likelihood of internal structure disruption – the formation of defects that affect the mechanical and electrical properties of the material. Defect levels of vacancies and oxygen complexes within the materialś bandgap determine radiative and non-radiative recombination processes. Radiative recombination, observed between donor and acceptor levels as evidenced in cathodoluminescence, dominates spectral features of the material.

It is measured that as the concentration of Sc atoms in AlScN increases, the position of the dominant spectral peak shifts to the longer wavelength spectrum and is determined by radiative recombination from complex oxygen defects in the crystal lattice. Additionally, at higher excitation power densities, a significant increase in the cathodoluminescence intensity of defect levels is observed, indicating an increasing density of radiative recombination channels – thermally activated complex oxygen defects in the material. When performing cathodoluminescence measurements at increasing modification densities, an increase in intensity is observed in compounds where the Sc concentration predominates up to 23%. Irreversible thermal modification, potentially occurring at a critical modification density, is observed when the Sc concentration in the compound reaches 41%.