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Non-linear dependence of the electric field gradient on the AlN content x in AlxGa(1-x)N

The ternary alloy systems based on AlN, GaN and InN are widely used in LEDs. The advantage is the continuous change in the bandgap that can be tailored by the alloy composition. Interestingly, the dependence of the bandgap on the constituents is not following Vegard's law which states that the lattice constants should change linear with the alloy content. But measurements show, that an additional bowing parameter has to be introduced to describe the dependence on the alloy contents. The electric field gradient (EFG) which is measured by the perturbed angular correlation method (PAC) depends on the c/a ratio of the lattice constants c and a of the Group III nitrides. So it is expected that the EFG follows Vegard's law as well and the question if the bowing parameter is correlated with the lattice constants can be addressed with PAC. Therefore the AlxGa(1-x)N system was studied at the ISOLDE facility. Samples with different AlN content x were implanted with the isotopes 111mCd and 117Cd. After the annealing of the implantation damage in flowing nitrogen PAC measurements were performed. The AlN molar fraction x was determined by Rutherford Backscattering experiments. The obtained results are compared to previous measurements with 111In and 181Hf. It can be shown that a bowing parameter has to be introduced to describe the dependence of AlN content and EFG in AlxGa(1-x)N. The bowing parameter depends on the implanted impurity which acts as PAC-Probe and interestingly not on temperature.

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