

UV transparent single-crystalline bulk AlN substrates

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Bulk aluminium nitride (AlN) is a very promising substrate material for UV optoelectronics based on AlGaN ternary compounds. AlN single crystals exceeding 1" in diameter can now be grown by physical vapour transport (PVT). UV transparency is of high interest for UV devices designed to emit through the substrate. We report on 500 μm thick bulk AlN substrates with plain UV transmittance exceeding 50% at wavelengths down to 220 nm in the whole wafer area. Additionally, below band-gap luminescence in such substrates is an order of magnitude lower as compared to excitonic luminescence at 77 K. The results are interpreted based on our point defect model for free-standing AlN crystals. We conclude that the concentration of both oxygen and aluminium vacancies considerably decreased in bulk crystals grown under optimized PVT conditions. This conclusion is supported by evaluation of point defect concentrations using chemical analysis, electron spin resonance, and positron annihilation.