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Polarization-induced charge carrier separation in GaN quantum dots on polar and nonpolar surfaces OLIVER MARQUARDT, TILMANN HICKEL, JOERG NEUGEBAUER, Max-Planck-Institut fuer Eisenforschung — Wurtzite III-nitride quantum dots (QDs) show a strongly reduced light emission efficiency when grown in the polar direction, due to strong built-in potentials which spatially separate electrons and holes, leading to weak recombination rates. To overcome this problem, QDs grown on nonpolar substrates have received much research interest, recently. We have compared GaN QDs grown on polar and nonpolar surfaces using an eight-band $\mathbf{k} \cdot \mathbf{p}$ model, employing geometries observed in recent experimental studies. Our studies indicate that the spatial separation of electrons and holes is even larger in QDs on nonpolar surfaces than in polar ones of comparable size, leading to even weaker recombination rates. A systematic investigation of various modifications on the above reference systems allowed us to identify the size of nonpolar QDs as the key parameter to achieve a higher efficiency in light emission processes. In particular, it has been found that this effect is stronger in nonpolar than in polar QDs by several orders of magnitude, making nonpolar QDs a promising research object for future light emission devices.

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