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The rare earth $4f$ hybridization with the GaN valence band LU WANG, WAI-NING MEI, Department of Physics, University of Nebraska at Omaha, Omaha, NE 68182, STEVE MCHALE, JOHN MCCLORY, JAMES PETROSKY, Department of Engineering Physics, Air Force Institute of Technology, OH 45433, J. WU, RATNAKAR PALAI, Department of Physics and Institute for Functional Nanomaterials, University of Puerto Rico, San Juan, Puerto Rico 00931, YAROSLAV LOSOVYJ, The J. Bennett Johnston Sr. Center for Advanced Microstructures and Devices, Louisiana State University, Baton Rouge, LA 70806, PETER DOWBEN, Department of Physics and Astronomy, University of Nebraska-Lincoln, Lincoln, NE 68588 — The placement of the Gd, Er, and Yb 4f states within the GaN valence band has been explored by both experiment and theory. The $4d$ – $4f$ photoemission resonances for various rare earth doped GaN thin films (RE = Gd, Er, Yb) provide an accurate depiction of the occupied $4f$ state placement within the GaN. The resonant photoemission show that the major Er and Gd rare earth $4f$ weight is at about 5-6 eV below the valence band maximum, similar to the $4f$ weights in the valence band of many other rare earth doped semiconductors. For Yb, there is very little resonant enhancement of the valence band of Yb doped GaN, consistent with a largely $4f^{14-\delta}$ occupancy. The placement of the rare earth $4f$ levels is in qualitative agreement with theoretical expectations.

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