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Probing the Surface Defect States of Gallium Nitride Nanowires LAUREN SIMONSEN, YUCHEN YANG, University of Utah, Department of Physics and Astronomy, NICHOLAS BORYS, Molecular Foundry, Lawrence Berkeley National Laboratory, ANIL GHIMIRE, University of Utah, Department of Physics and Astronomy, JAMES SCHUCK, SHAUL ALONI, Molecular Foundry, Lawrence Berkeley National Laboratory, JORDAN GERTON, University of Utah, Department of Physics and Astronomy — In this work, we investigate gallium nitride nanowires (NWs) as a potential system for solar-driven water splitting. Although bulk GaN has a UV bandgap, the synthesized NWs exhibit strong absorption and fluorescence emission across the visible spectrum. Density functional theory calculations suggest that this visible fluorescence originates from mid-gap surface-defect states along the triangular facets of the NWs. The orientation of the NWs can be controlled during MOCVD growth, leading to different exposed crystallographic surface terminations with various electronic structures. High resolution microscopy techniques using AFM and confocal hyper-spectral imaging show spectral inhomogeneity across the widths of the NWs, providing evidence that various crystallographic terminations produce different surface states. These NWs also exhibit wave guiding properties, leading to Fabry-Perot fringes and high intensity spectra at the ends of the wires. Photoluminescence excitation spectroscopy reveals a non-linear dependence of the emission spectral features on excitation wavelength, indicating a complex distribution of mid-gap defect states. Time-resolved spectroscopy reveals non-exponential decay dynamics through a complicated manifold of mid-gap states.

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