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Lanthanide impurities in wide bandgap semiconductors: A possible roadmap for spintronic devices

Appl. Phys. Lett. **102**, 062101 (2013); <https://doi.org/10.1063/1.4791787>G. Caroena¹, W. V. M. Machado¹, J. F. Justo², and L. V. C. Assali¹[View Affiliations](#)[View Contributors](#) PDF

ABSTRACT

The electronic properties of lanthanide (from Eu to Tm) impurities in wurtzite gallium nitride and zinc oxide were investigated by first principles calculations, using an all electron methodology plus a Hubbard potential correction. The results indicated that the 4f-related energy levels remain outside the bandgap in both materials, in good agreement with a recent phenomenological model, based on experimental data. Additionally, zinc oxide doped with lanthanide impurities became an n-type material, showing a coupling between the 4f-related spin polarized states and the carriers. This coupling may generate spin polarized currents, which could lead to applications in spintronic devices.

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