Near Zero-Field Magnetoresistance and Defects in GaN pn Junctions

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We report on observation of near zero-field magnetoresistance (NZFMR) in GaN devices, in this case, pn junction diodes. NZFMR is a new technique with great potential in electronic materials physics. [1,2] The NZFMR response is due to recombination centers within the diode depletion regions. A representative NZFMR amplitude versus magnetic field plot is shown in figure 1. Figure 2(a) illustrates the anticipated depletion region 2(b) shows the measured NZFMR amplitude versus junction bias. The agreement between the calculated response of figure 2(a) and the experimental observations of figure 2(b) should be considered reasonably convincing, considering multiple approximations involved. The NZFMR pattern peaked near the built-in voltage is expected from recombination within the depletion region. [3,4] The NZFMR phenomena are somewhat similar to low field magnetoresistance phenomena observed in some organic semiconductors. The NZFMR response can be understood within the framework of the stochastic quantum Liouville expression. [1,2] Preliminary analysis of traces represented by figure 3, based upon this framework, indicates that the NZFMR response is consistent with nitrogen vacancies.
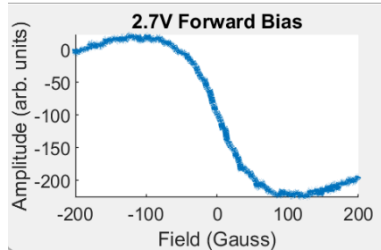

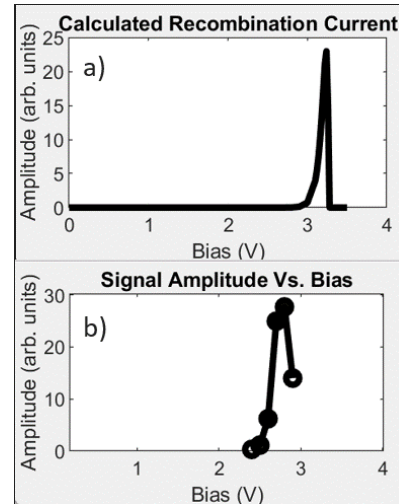Figure 1. An example of an NZFMR trace in a GaN pn diode.

Figure 2. (a) Calculated recombination current in diode. (b) observed NZFMR amplitude with respect to forward bias.

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