N-type doping of GaAs Nanowires using GaTe Source grown by Self Assisted Molecular Beam Epitaxy

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N-type doping of GaAs nanowires (NWs) grown by molecular beam epitaxy (MBE) on (111) Si substrate using gallium telluride (GaTe) as a dopant source is successfully reported. A detailed study has been carried out to assess the impact of variation of GaTe source cell temperature on morphology, electrical and optical properties of NWs. Tellurium (Te) doping in the NWs was investigated for GaTe cell temperatures ranging from 200^{o}C to 570^{o}C. The variations in the optical, electrical and morphological characteristics with cell temperature were investigated using low-temperature photoluminescence (PL), atomic force microscopy (AFM) and scanning electron microscopy (SEM). Te incorporation in our NWs was attested by the presence of 4K PL shoulder peak, which is~0.18 eV red shifted with respect to GaAs band to band transition at 1.50 eV. Moreover, a shift in the PL peaks, variation in their full width maxima and corresponding variation in the I-V characteristics from AFM were used to ascertain the increase in Te incorporation in the NWs with increasing cell tempature. Best fitting of the simulated I-V curves with the experimental data on a single NW obtained from AFM yielded the highest carrier concentratining of $2.2*10^{17}/cm^3$ with a carrier mobility of 7500 cm^2/ Vs. The highest responsivity of Te doped NW/p-Si was found to be 64 mA/W. Transmission electron microscopy (TEM) investigations of these NWs will also be presented.

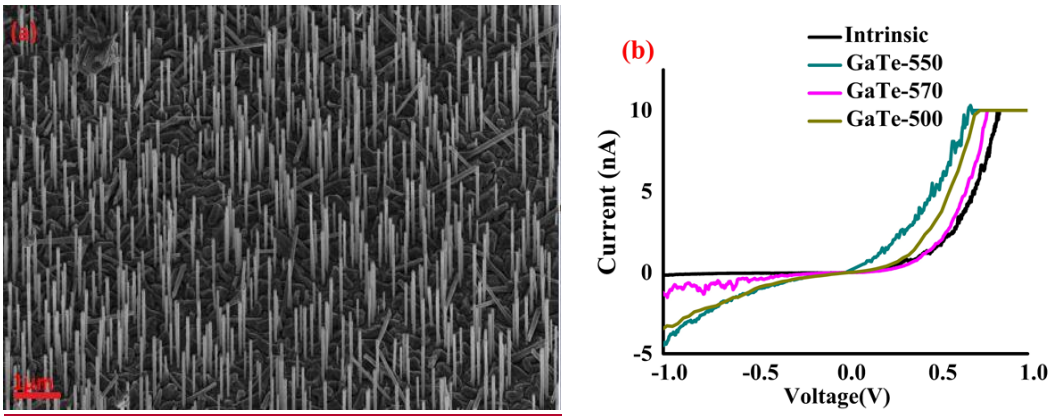

Figure 1. (a) SEM image (scale 1μm and sample inclined at 45^{o}) of Te doped GaAs NWs grown on p-Si (111) substrate, (b) IV characterstics of doped single NWs obtained by AFM.

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Supplementary Pages (Optional)

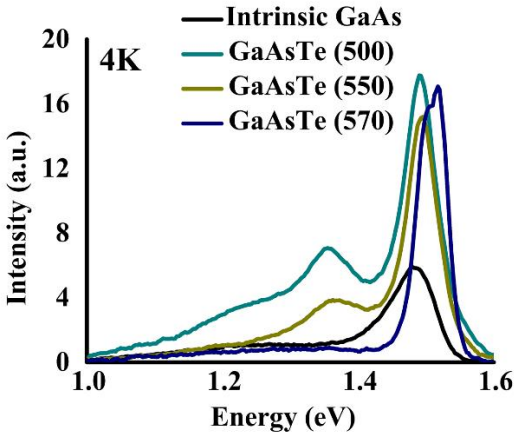

Figure S1. 4K Photoluminescence spectroscopy of intrinsic and Te doped NWs at different temperatures.

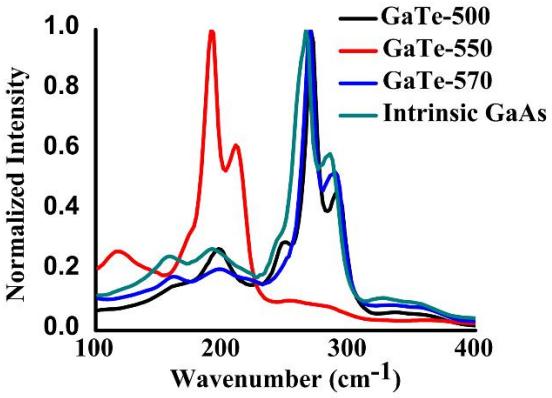

Figure S2. Raman spectroscopy of intrinsic and Te doped NWs at different temperatures.