EFFECT OF HYDROGEN ON THE CHARGE TRANSPORT PROPERTIES OF NON-INTENTIONALLY DOPED N-GAN AND OF THE GAN/ALGAN HEMT

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GaN and its alloys posses outstanding physical properties such as high free carrier saturation velocity, high mobility, high breakdown electric field (3MV/cm) as well as high physical and chemical stability. They constitute the active elements of a number of devices as, high electron mobility transistors (AlGaN/GaN HEMTs), ultraviolet and infrared detectors, non linear optical structures and, tera-hertz sources and detectors, among others. Usually grown on foreign substrates with which exist a large lattice and thermal mismatch results a highly defective material, with threading dislocation densities (TDs), NT, in the range 107-1011 cm-2. TDs in n-GaN capture electrons, building up an energy barrier highly efficient at scattering and recombining carriers constituting a highly

degrading factor of the physical properties of GaN as well as of its devices. On the other side, it is well known that hydrogen in semiconductors usually, although not always, bonds to defects, shallow and deep, resulting on their passivation; the strip-off of their initial electronic properties, such change might improve devices performance. In GaN it has been shown that hydrogen passivates Mg, Ca and C acceptors. Although, in-diffusing hydrogen in nid-n-GaN under improper conditions might result on a severe degradation of its physical properties.

In this presentation it will be shown that the proper hydrogenation of n-GaN passivates dislocations resulting on an important improvement of the material physical properties. Some of those improvements have been transferred as well into AlGaN/GaN HEMTs. To asses the hydrogen effect on the n-GaN physical properties the in diffused layers have been studied by SIMS, resistivity and Hall measurements as well as photoluminescence. Preliminary results obtained on the performance of AlGaN/GaN HEMTs featuring a 1.0 m of gate length are extremely interesting inviting to explore more deeply these effects. All these results will be widely discussed in this presentation.