Towards high electrical conductivity of hexagonal boron nitride

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Hexagonal boron nitride (h-BN) is a very promising candidate for optoelectronic applications in the deep ultraviolet spectral range due to its exceptional physical properties, such as high chemical stability, thermal conductivity and wide bandgap energy. A large cross section for neutron capture renders BN an outstanding candidate for neutron detectors, while the possibility of effective p-type doping opens up new possibilities of application as a transparent contact in deep ultraviolet (DUV) light emitting devices based on nitrides. However, achieving high electrical conductivity of boron nitride still remains very challenging.

In this communication we present the influence of post-growth thermal annealing on the conductivity of epitaxial h-BN grown by Metal Organic Vapour Epitaxy (MOVPE). Such a procedure, aimed to remove hydrogen that passivates acceptors from the epitaxial material was very successfully employed in the case of Mg doped GaN.

The investigated samples were annealed in a molecular nitrogen atmosphere at 1000 ºC for 10 minutes. A gold-palladium alloy was used to obtain photodetector structures by a maskless lithography system in a lift-off process. Thermal annealing in nitrogen atmosphere for 10 min leads to substantial increase of electrical conductivity, which could be explained by a release of hydrogen and/or changes in actual defect concentration of our layers.

In order to shed more light to this idea room temperature photocurrent spectra of our epitaxial layers were measured. A laser-driven light source was used to excite a photocurrent in the range 170-1000 nm. Broad photocurrent peaks, that may be associated with deep defects centers, were detected in the visible and near UV region. Signals related to excitonic transitions in the DUV range are also observed. The obtained results allow us to discuss different strategies for obtaining highly conductive p-type hBN useful for DUV optoelectronics.

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