UV single photon emission from quantum dots embedded in (Al,Ga)N nanowires

E.M. Łacińska[1], T. Fąs[1], J. Suffczyński[1], K.P. Korona[1], M. Sobańska[2], K. Kłosek[2], Z.R. Żytkiewicz[2], A. Wysmołek[1]

[1] *Faculty of Physics, University of Warsaw, Pasteura 5, Warsaw, Poland*

[2] *Institute of Physics, Polish Academy of Sciences, Al. Lotników 32/46, Warsaw, Poland*

Single photons are widely used in quantum computing or quantum cryptography. Among available non-classical emitters semiconductor nanostructures, such as quantum dots, are implemented most widely. Here we show that quantum dots formed in (Al,Ga)N nanowires act as an efficient source of single photons.

The sample is grown by plasma-assisted Molecular Beam Epitaxy. It contains (Al,Ga)N nanowires with three layers of GaN quantum wells (QWs) embedded between p-type $Al_{0.15}Ga_{0.85}N$. Scanning Electron Microscopy reveals sub-μm diameter of the nanowires. The QWs form 3.5 nm thick disks with diameter of around 50 nm. In such disk, even small potential fluctuation is enough to reduce space available for electrons to quantum dimensions and create a quantum dot. The potential fluctuations can be caused by (Al,Ga)N barrier composition inhomogeneity, strain or structural defects, such as inversion domains.

The μ-Photoluminescence (μ-PL) is excited with 3.81 eV laser energy at T = 1.8 K. Confocal, immersion type microscope allows limiting the diameter of the excitation spot to 0.5 μm. The μ-PL spectrum is composed of a large number of spectrally narrow (down to 0.2 meV) lines between 3.44 eV and 3.76 eV attributed to defect emission in (Al,Ga)N. Hanbury-Brown and Twiss set up is used for single photon correlations measurements. Photon multipliers with 0.6 ns of temporal resolution serve as detectors. The histogram obtained in correlation measurement on the transition at 3541 meV is shown in Fig. 1. It demonstrates a significant drop at zero delay with a value below the limit of 50% of correlated counts level at large delays. It is a clear signature of single photon emission.

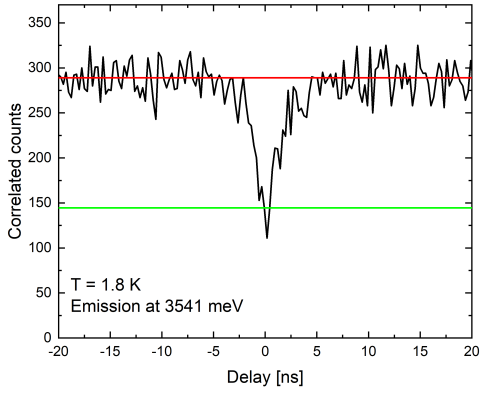

Figure 1: Single photon correlation histogram measured for the transition at 3541 meV. The green line shows the 50% level of correlated counts.

Our work indicates a novel source of single photons in so far less explored in this view ultra-violet spectral range.