Bright CdSe/ZnSe nanowire-quantum dots for single photons emission

S. Bounouar, M. Elouneg-Jamroz, G. Sallen, M. Den Hertog, C. Morchutt, E. Bellet-Amalric , R. André, C. Bougerol, J.P. Poizat, S. Tatarenko and **K. Kheng**

Nanophysics and Semiconductors Group,
INAC and Institut NEEL, CEA/CNRS/University Joseph Fourier
CEA-Grenoble, 17 rue des Martyrs, 38054 Grenoble, France

kkheng@cea.fr

Semiconductor nanowires (NW) are appealing structures that allow designing quantum structure with unprecedented freedom. With NW, new type of quantum dot (QD) heterostructures (NW-QD) can be directly grown on defined positions without the necessity of self-assembly, as well as more complex structures such as coupled QDs or core-shell structure. However, the quantum confinement requires growing NW with very small lateral size (of the order o the Bohr radius) with high crystalline structure and clean surfaces (to prevent quenching of the exciton emission through non radiative recombination.

Using MBE in the vapour-liquid-solid growth mode (VLS) we have developed the growth of very high quality ZnSe nanowire [1] with typical diameter of 10 nm (strong confinement regime). We have demonstrated recently that a single CdSe quantum dot embedded in such a ZnSe NW can emit single photons up to 220K [2]. We will present our recent progress over the growth and optical studies on ZnSe/CdSe NW-QD. The quality of our NW is good enough to allow investigating very fine optical properties in single NWs. In pure ZnSe NW, we can observe the band edge emission at 442nm. In ZnSe/CdSe NW-QD, photon correlations measurements have allowed to unambigously identify exciton, biexciton and trion [3] as well as to study the dynamics, in the nanosecond scale, of the spectral diffusion mechanism [4].

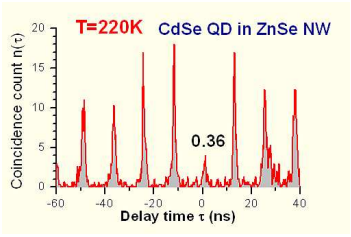

Fig. 1) Single photon emission at 220K [2]

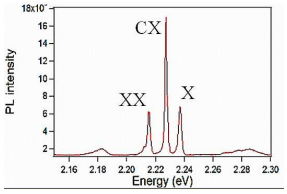

Fig. 2) Exciton, biexciton and charged exciton emission in single CdSe/ZnSe NW-QD [3]

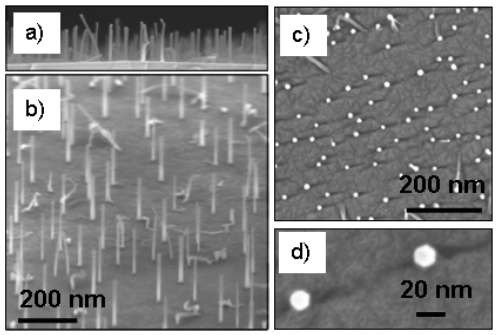

Fig. 3. SEM images ZnSe NWs grown on a ZnSe (111)B buffer layer. Side (a,b) and top (c,d) views.

References

[1] T. Aichele et al., Appl. Phys. Lett. **93**, 143106 (2008)

[2] A. Tribu, et al., Nano Lett., **8** (12), 4326 (2008)

[3] G. Sallen et al., Phys. Rev. **B 80**, 085310 (2009)

[4] G. Sallen , A. Tribu , T. Aichele, R. Andre, L. Besombes , C Bougerol , M. Richard , S. Tatarenko, K. Kheng, JP Poizat, Nature Photonics **4**, 696 (2010)