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ZnO Nanowires on Graphite with Improved UV Photoluminescence

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INTRODUCTION

Broadband semiconductors (such as ZnO) stand out in opto and microelectronics as they allow the development of transparent electronics. ZnO, with its diverse nanostructured morphologies (nanowires, nanorods, nanocrystalline thin films, etc.) is an extremely attractive compound to use in a great variety of nanotechnological applications. ZnO also exhibits a high exciton biding energy of 60 meV and a prohibited bandwidth in the UV (3,37 eV), making it a great candidate for applications in optoelectronics[1,2]. In this work, a detailed characterization of the morphology and photoluminescence (PL) properties of ZnO nanowires (NWs) grown on different carbon substrate is presented.

EXPERIMENTAL STUDY

ZnO NWs were grown through the vapor-phase transport method, on carbon substrates (compacted graphite and carbon fibers) in a tubular furnace under Ar and O flow. In contrast to NWs grown on Si or other semiconductor substrates, metallic catalysers[3] are not necessary, as the NWs growth occurs directly on the surface of the carbon substrates. The morphology, chemical composition and the stoichiometry of the NWs grown, as well as the main characteristics of the valence band density of states close to Fermi level, were studied by x-ray photoelectron spectroscopy (XPS). Photoluminescence spectra were also measured.

RESULTS AND DISCUSSION

PL dependence with excitation power was measured and analyzed in the different samples: ZnO NWs on compacted graphite; ZnO NWs on carbon fibers; ZnO NWs transferred on Si; and ZnO crystal (see Fig. 1) as well as the evolution of the ultraviolet (UV) and green emission intensities for all the samples (see Fig. 2). The results show an increase by 3 orders of magnitude in the UV emission intensity for the NWs grown on compacted graphite with respect to the UV intensity measured in the others samples and also in comparison to results obtained in a previous work[4].

CONCLUSION

Increasing the emission efficiency is of great interest for applications in photonics and UV optoelectronics, and is usually achieved from the inhibition of visible emission, with the consequent increase in UV emission[5]. However, in the ZnO NWs grown on compacted graphite it was found that the high efficiency is produced by a considerable increase in UV intensity without the need to suppress the visible emission.

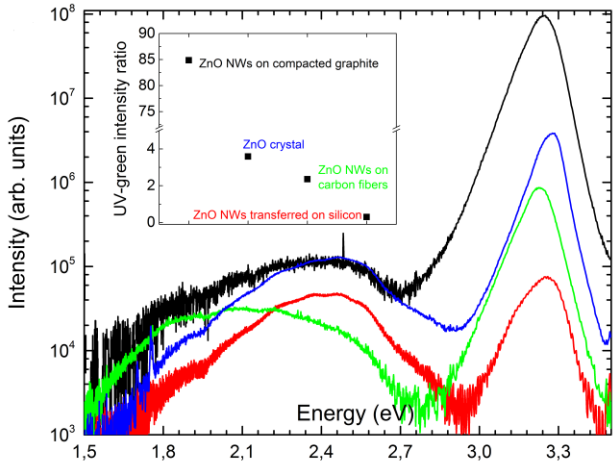

Fig. 1 PL spectra for different ZnO samples. On the inset, emission efficiency for each sample is presented

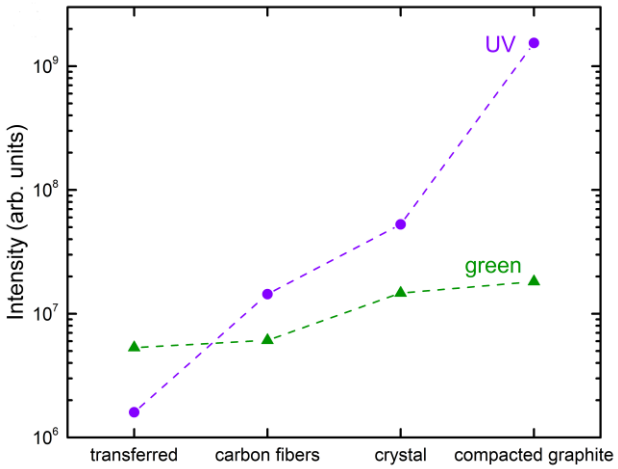

Fig. 2 Evolution of UV and green emission intensities

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