BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA INSTITUTO DE FÍSICA



"Ing. Luis Rivera Terrazas"

SEMINARIO SEMANAL

"Jesús Reyes Corona"



"Optical Spectroscopy of ZnO nanowires and Applications"

Dr. Frank Güell

Profesor Titular Institut de Nanociencia y Nanotecnología Universitat de Barcelona, España

The quest for novel semiconductor materials with improved optoelectronic performance has triggered intense research activities to exploit the great diversity of effects offered by low dimensional systems. In this work, we investigate the influence of the ZnO nanowires (NWs) growth parameters on their optical properties. ZnO NWs have been grown by the vapor-transport method using Au as catalyst over quartz and SiO₂/Si substrates with lengths and diameters ranging from 0.2 to 2 µm and 40 to 200 nm, respectively. Room-temperature absorption spectra show a well-defined exciton peak in the ultraviolet. Photoluminescence measurements show two emission bands at roomtemperature, the exciton emission peak in the ultraviolet, and a very broad emission band in the visible range from 420 to 800 nm, which exhibits three distinct peak-like contributions in the Green, Yellow and Red at around 520, 590 and 720 nm (2.38, 2.10 and 1.72 eV), respectively. The intensities of these emission bands in the visible change as a function of the ZnO NW growth parameters, which correspond to different defect-related recombination processes, and were clearly correlated with the quantity and type of defects present in the material. We show that the intensity of the broad emission band in the visible increases relative to that of the exciton emission as the ZnO NWs diameter decreases. This result is of great relevance regarding future devices based on these nanostructures since a detailed understanding of the origin of the shell states (surface states) is mandatory for a precise device design. The highly spatially localized nature of the shell states is a fundamental aspect to control in applications where charge transfer processes play a key role, e.g., detectors such as gas sensors, or even photocatalytic activity.

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