High Resolution, Two-Dimensional Image Mapping of ZnO Nanowires by Confocal MicroPhotoluminescence and MicroRaman Spectroscopy

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One-dimensional nanostructure, especially semiconductor nanowire has been an on-going research interest due to their peculiar optical and physical properties, and its potential use for a wide range of the applications for electronics, photonics, and magnetic devices. They can also potentially serve as template matrices for nanoscale sensors. Zinc Oxide (ZnO), with its large bandgap energy of 3.37 eV and an exciton binding energy, is a promising semiconductor materials for an optical devices ranging from solid state lighting to photovoltaics . ZnO nanowires have recently attracted a lot of interest because of their good crystalline quality and unique optical characteristics. However, realizing well aligned nanowires has remained challenging, and often it is reported in various shapes and orientations of the nanowires by many other research groups. Surprisingly, the optical properties have not been clearly correlated in terms of the shapes, orientations and other variations that nanowires have. High quality ZnO nanowires were synthesized using both Au catalysts and ZnO seeds by chemical vapor deposition and their optical properties studied using photoluminescence and Raman spectroscopy combined with confocal laser scanning microscopy. Strong UV near band edge along with defect related visible luminescence emissions were observed and their relative intensity compared. We show a strong dependence of the luminescence as a function of depth along the axis of the nanowires as well as spatial distribution over the sample surface by implementing two-dimensional photoluminescence mapping. We also report two-dimensional mapping of Raman scattering.