Cathodoluminescence of InP-InGaP Nanowires

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Semiconductor nanowires (NWs) are promising candidates for the new generation of tandem solar cells. The main advantage of nanowires is the high surface-to-volume ratios, their reduced dimension, the relaxed-lattice matching, and their behavior as optic antennas. All these unique properties allow to growth complex structures not allowed in a planar configuration, which improves the photon harvesting capabilities of the NWs-based solar cells and the power conversion efficiency of these devices. The NWs characterization is the first step to understanding their properties, and the luminescence emission in semiconductor nanowires yields valuable information about their optical properties, composition, and doping.

Herein, we report the luminescence emission of a single InP - InGaP heterostructured NW by cathodoluminescence (CL) with submicrometric spatial resolution. Spectrally resolved CL allows to obtain an approximation to the composition of the NW. The bottom of the NW exhibits the emission at 1.42 eV associated with InP, an additional emission around 1.60 eV is also observed. Scanning Electron microscope (SEM) images reveal a slightly tapered shape of the NWs. The 1.6 eV emission suggests that a poor Ga InGaP parasitic shell is deposited laterally on the InP NW section. The CL spectra along this section of the wire evidence the non-uniform composition of this parasitic shell. Moreover, the luminescence intensity of the parasitic shell is significantly stronger than the emission arising from the InGaP section of the NW, due to the high gallium concentration in this sector of the NW, which is close to the indirect bandgap.