

Passivation of gallium arsenide nanowire sidewalls for photovoltaic applications

A. Chia, R.R. LaPierre

Department of Engineering Physics, McMaster University
Hamilton, Ontario, Canada L8S 4L7

Core-shell p-n junction nanowires (NWs) may improve photovoltaic cell efficiency due to superior light trapping abilities, increased active region area and shorter carrier collection lengths. Recent studies showed a decreased efficiency in core-shell gallium arsenide (GaAs) NWs with thin shells as compared to NWs with thick shells, but of the same overall size. Two possible explanations for this include the complete depletion of the shell and surface recombination of charge carriers on the nanowire sidewalls, stressing the need for a wide bandgap passivation layer. This need was addressed by the deposition of AlInP passivation shells on core-shell GaAs NWs. Furthermore, the AlInP shell was partly oxidized to increase the bandgap in order to achieve greater confinement of the charge carriers to the GaAs NW. Scanning electron microscopy was used to study the dimensions and density of NWs and the uniformity in the AlInP shell thickness along the length of the wires. Transmission electron microscopy and energy dispersive spectroscopy were used to examine the depth of oxidation and the composition of the AlInP shell. Finally, photoluminescence was used to analyze the degree of carrier confinement compared to unpassivated GaAs NWs.