GaAs Nanowires based Hybrid Organic Solar Cell

Abstract
Semiconductor nanowires (NWs) have demonstrated their great potentials as the building blocks for the future electronic and photonic devices. Integration of NWs on transparent conductive oxide substrate is essential for developing hybrid solar cells (HSC). In this work, GaAs NWs are successfully grown directly on indium tin oxide (ITO) coated glass substrate by metalorganic chemical vapor deposition (MOCVD). Simulation predict 13% power conversion efficiency of GaAs/P3HT HSC. This demonstrates the potential application of GaAs NWs based hybrid solar cell.

Background & Objective

Why GaAs?

- Excellent optical & electrical properties
- High electron mobility
- Direct band gap etc.

Why NWs?

- High aspect ratio
- No lattice mismatch issue
- Material saving

Why ITO?

- Excellent transmittance & conductivity
- Chemical stability
- ~ 20 nm grain size

Why HSC?

- Higher photon absorption
- Continuous paths to electrodes
- High reliability

GaAs NWs Grown on ITO

Due to the polycrystalline nature of the substrate, no single growth direction is favored but most of the NWs have large tilt angles with the substrate. For 200 NWs calculated, over 96% of them have tilt angle larger than 45°

Simulation Results

- Initially PCE of the device rises with the nanowire size and reaches maximum values before falls down

Photovoltaic Process

Staggered band gap alignment is formed among GaAs nanowires and organics
Excitons are generated upon illumination by nanowires and organic materials
Carriers transport through different pathways and are collected by respective electrodes

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