

# GaAs Nanowires Based Hybrid Organic Solar Cell

## Abstract

Semiconductor nanowires (NWs) have demonstrated the great potential 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  
Higher carriers extraction

### GaAs Nanowires based HSC

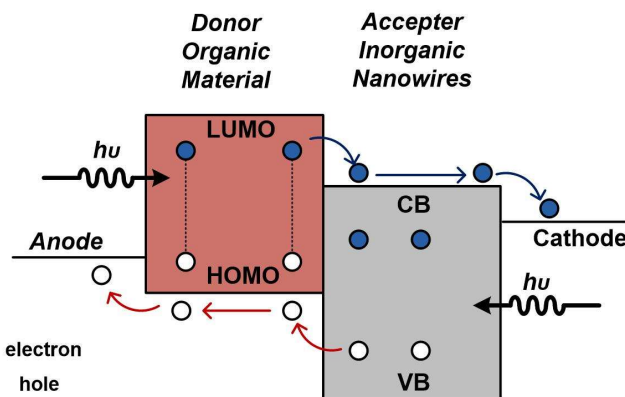
### Why ITO?

Excellent transmittance & conductivity  
Chemical stability  
~ 20 nm grain size

### Why HSC?

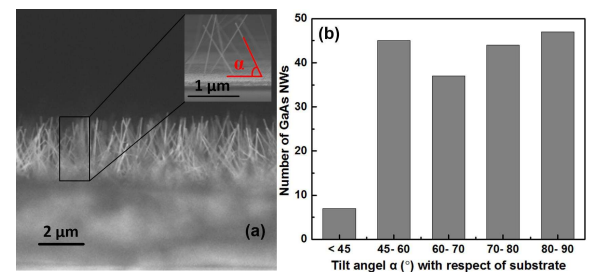
Higher photon absorption  
Continuous paths to electrodes  
High reliability

## Photovoltaic Process



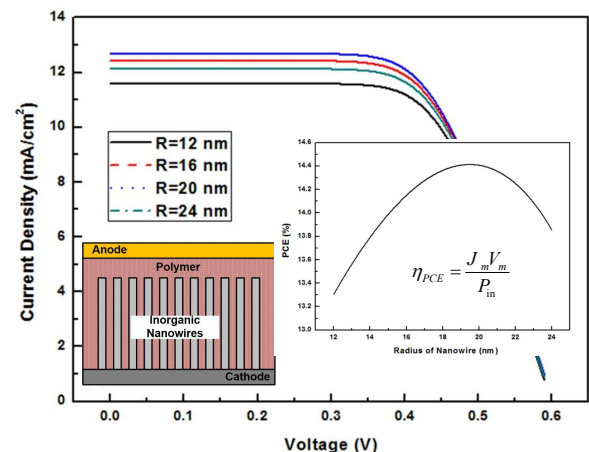
- ✓ Staggered band gap alignment is formed among GaAs nanowires and organics
- ✓ Excitons are generated upon illumination by nanowires and organic materials
- ✓ Carriers transport through different pathways and are collected by respective electrodes

## 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 the 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

### Project Members:

Assoc Prof. Tang Xiaohong, Ms. Wu Dan, Mr. Li Xianqiang,  
Dr. Aurelien Olivier  
Email: EXHTANG@ntu.edu.sg  
Tel: +65 6790 4438

### Acknowledgment:

Sponsored by MOE: RG97/14