Photovoltaic Windows for Green Building

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**Motivation**
- Urban High-Rise Construction has little available roof space for conventional solar cells
- Need for aesthetic solar PVs which can be seamlessly integrated into Residential and Commercial architecture

**Solution**
- Transparent photovoltaic fabricated from gallium-arsenide Nanopillars embedded in a flexible polymer matrix with conducting polymer contacts.
- Projected power densities of 50W/m² for pillar density of 1/μm²
- Transparency inversely proportional to pillar density, with prism-like diffraction.

**Current Capability**

**Pillars Transferred to Transparent Polymer**

- **Photoluminescence of Nanopillars in Polymer**
- Nanopillar Sample
- Embedded in Polymer
- Pillars transferred to polymer are
  - Flexible
  - Transparent
  - Exhibit Strong Photo-Response

**Hybrid Nanopillar/Polymer PhotoVoltaic**

- **Nanopillars Coated with P3HT (semiconducting polymer)**
- **Nanopillar Coated with P3HT and ITO (Indium Tin Oxide)**
- Initial Results for Hybrid Nanopillar PV
  - Low Leakage Currents
  - Fill Factors > 40%
  - Solar Conversion Efficiency 1-2%

**Proposed Photovoltaic Window**

- Original Nanopillar Sample
- Etch Back Polymer
- Spin Coat Insulating Polymer
- Drop-Cast Conducting Polymer
- Remove From Substrate
- Spin Coat Conducting Polymer

- **Simulation of Window with Transparent PV Overlay**
  - A Gallium Arsenide P-N Junction converts light into electricity
  - Transparent Conducting polymer contacts to extract carriers
  - Potential to reuse gallium-arsenide substrate
  - High carrier mobility in GaAs
  - Low carrier mobility in polymer
  - Average of ~1trillion nanopillars/m²