Docket #: S09-418

Nanofiber Transparent Electrodes

Researchers in Prof. Yi Cui's laboratory have used a novel electrospinning process to fabricate a unique, transparent, highly conductive metal nanofiber material that could be used to replace indium tin oxide (ITO) in transparent electrodes. The fibers have a diameter of 30-100 nm and a length up to ~1 cm. The electrodes made from this network can be either isotropical or anisotropical and can be applied to a rigid or flexible substrate. This low-cost nanofiber could be used for a wide variety of transparent electrode applications, with properties particularly well-suited for large scale solar cells, touchscreens, or large-scale lighting and displays.

Stage of Research
The inventors have developed the electrospinning process and fabricated copper nanofibers with ultrahigh aspect ratios (up to 100,000) and fused crossing points with ultralow junction resistances, which resulted in high transmittance at low sheet resistance with great flexibility and stretchability. The inventors demonstrated this material on organic solar cells, with power efficiency comparable to ITO devices.

Applications

- **Transparent electrode material** (ITO alternative) for:
  - large scale solar cells
  - flexible electronics
  - touch screens – particularly capacitive touch screens where anisotropical conductor lines are needed
  - large scale lighting with LED system
  - polarizers

Advantages

- **High performance:**

    - high transmittance at low sheet resistance (e.g. 90% at 50 ohm/sq)
    - organic solar cells using copper nanowire networks have power efficiency of 3.0% (comparable to ITO)
- Can be **aligned** into oriented arrays and grids, if anistropical conduction is preferred
- **Flexible** - if preferred, the mechanical flexibilities of the nanofiber network on the plastic substrates are robust due to their large aspect ratios
- **Large scale**
- **Low cost** - raw materials are less expensive than indium or silver
- **Simple process** - electrospinning fibers with heat treatment

Publications

- Hui Wu, Liangbing Hu, Michael W. Rowell, Desheng Kong, Judy J. Cha, James R. McDonough, Jia Zhu, Yuan Yang, Michael D. McGehee and Yi Cui, "Electrospun Metal Nanofiber Webs as High-Performance Transparent Electrode", *Nano Letters*, published online August 25, 2010.

Patents

- Published Application: 20120061124
- Issued: 8,940,194 (USA)

Innovators

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