Two-Step Processing With Vapor Treatment Of Thin Films Of Organic-Inorganic Perovskite Materials

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SUMMARY

Prof. Yang and colleagues have developed a novel method of preparing organic-inorganic thin films using a solution process followed by vapor treatment, presenting a low-cost, high-performance solution method of producing optoelectronic devices.

BACKGROUND

Organic-inorganic hybrid materials, particularly including perovskite-family materials, represent a new class of materials that may combine desirable properties of both organic and inorganic materials. Organic materials have low manufacturing costs and versatile properties and applications for electronic devices. Inorganic materials typically produce higher performing devices, but require expensive, complicated manufacturing and have limited application versatility. Perovskite hybrid materials have been proven to combine the high performance of inorganic materials with the flexibility of organic materials. However, the highest performing perovskite-based devices typically are fabricated using costly vacuum deposition techniques and high temperatures. An alternative method, along with improvements in performance, would allow the perovskite-based electronic devices to be competitive alternatives to traditional silicon and other inorganic technologies.

INNOVATION

Professor Yang and colleagues have developed a method of preparing organic-inorganic thin films using a solution process followed by a vapor treatment, instead of the standard costly vacuum deposition methods. This process maintains properties similar to perovskite materials-based electronics fabricated using vacuum deposition methods, while offering the low cost and flexibility of solution processing. Applications of this technology include lasers, photovoltaics, LEDs, field-effect transistors and superconductors.

APPLICATIONS

- Grid solar cells
- Portable solar cells
- LEDs
- Field-effect transistors
- Wearable electronics

ADVANTAGES

- High performance electronic devices, including solar cells with 15% efficiency
- Solution processable – low cost and versatile manufacturing
- Uses inexpensive, well-studied materials for many layers
- May use a variety of substrates, including flexible plastics

STATE OF DEVELOPMENT

Prototype perovskite-based solar cell devices have been fabricated with efficiencies of 15%.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,075,350	07/27/2021	2014-251
United States Of America	Issued Patent	10,403,836	09/03/2019	2014-251

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INVENTORS

- Yang, Yang

OTHER INFORMATION

KEYWORDS

Solar cell, photovoltaic, renewable, OPV, organic, polymer solar cell, perovskite, alternative energy, solution process

CATEGORIZED AS

- **Computer**
  - Hardware
- **Energy**
  - Lighting
  - Solar
- **Materials & Chemicals**
  - Nanomaterials
  - Polymers
  - Thin Films
- **Semiconductors**
  - Design and Fabrication
  - Materials
  - Processing and Production

RELATED CASES

2014-251-0

RELATED MATERIALS

- Huanping Zhou, et al. Science, 345, 542(2014)
- Qi Chen, et al. Journal of American Chemical Society, 136 (2), 622–625 (2014)

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Titanium Oxide as the Window Layer for Metal Chalcogenide Photovoltaic Devices
- Efficient and Stable Perovskite Solar Cells with All Solution Processed Metal Oxide Transporting Layers
- High Performance and Flexible Chemical And Bio Sensors Using Metal Oxide Semiconductors
- Design of Semi-Transparent, Transparent, Stacked or Top-Illuminated Organic Photovoltaic Devices
- Novel Polymers for Polymer Solar Cells, Transistors, and Sensors

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