Photo-induced Metal Printing Technique for Creating Metal Patterns and Structures Under Room Temperature

Tech ID: 29425 / UC Case 2018-377-0

SUMMARY

UCLA researchers in the Department of Materials Science and Engineering have developed a low-temperature metal patterning technique.

BACKGROUND

Metal deposition and patterning is a widely used technique in fabricating magnetic, electronic, and optoelectronic devices. Currently, there are three main approaches to metal patterning: 1) using a physical mask with pre-designed patterns,2) inkjet printing and 3) selective laser sintering (SLS). However, using a physical mask requires deposition techniques under vacuum which results in physical contact-induced contamination and limited resolution, and inkjet printing devices easily clog due to the ink's viscosity. SLS uses a metal power bed with hazard and contamination issues and operates at higher temperatures, which limits the substrate materials that can be used, particularly plastics that are used in flexible electronics. Moreover, patterning technologies are evaluated by the electrical conductivity of the printed patterns. Yet a tradeoff exists between high electrical conductance performance and reducing manufacturing temperatures toward increasing substrate versatility. Thus, there is a need to achieve patterns with high electrical conductivities while being manufactured at lower temperatures.

INNOVATION

UCLA researchers have developed a high-resolution metal deposition and patterning technique. The silver patterns formed by this technique exhibit high electrical conductivity, comparable to or better than the conductivity of silver printed by laser sintering or thermal annealing. The patterning method operates at room temperature, which avoids damaging low-melting-point components or substrates made from plastics. The printing solution is particle-free and solvent-free, and thus easy to operate and environmentally friendly. This technique can print multiple different metals, as a universal platform with the potential to broaden further. The technique can create 2D patterns or 3D structures on a variety of substrates, including plastics, silicon, and paper. Moreover, the simple setup is commercially scalable, avoids costly optical parts, and uses a lower-energy visible light source (compared with commonly used UV light). Overall, this novel room-temperature, particle-free metal patterning is highly desirable for fabricating electronic devices, including integrated circuits, transistors, and sensors.

APPLICATIONS

- Integrated circuits
- Transistors
- Sensors
- Flexible electronics
- Electrodes for OLED solar cells

ADVANTAGES

- High electrical conductivity
- Operates at room temperature
- Much faster than ink jet printing
- Diverse substrate capabilities
- Setup is commercially scalable and avoids costly parts
- Very high resolution (3 to 5 micrometers)
- Particle-free and seed-free

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OTHER INFORMATION

KEYWORDS

metal printing, metal patterning, photolithography, photosensitive metal ink, low temperature patterning, flexible electronics

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Materials & Chemicals**
  - Nanomaterials
  - Thin Films
- **Nanotechnology**
  - Electronics
- **Semiconductors**
  - Processing and Production

RELATED CASES

2018-377-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,639,025	05/02/2023	2018-377

RELATED MATERIALS

- X. Yang, M. Sun, Y. Bian, X. He, A Room-Temperature High-Conductivity Metal Printing Paradigm with Visible-Light Projection Lithography. Adv. Funct. Mater. 2019, 29, 1807615.

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Materials for Autonomous Tracking, Guiding, Modulating, and Harvesting of Energetic Emissions

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