Self-Aligned Deposition via Spin Coating without Pretreatment

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BACKGROUND

Thin-film patterning techniques enable a wide variety of advanced electronic devices. Many target structures require the sequential patterning of multiple layers that include different types of materials, often imposing stringent overlay demands that increase the complexity and cost of processing. Self-aligned patterning can in principle ease these challenges by controlling the topography and/or surface chemistry of the underlying substrate. However, it is frequently inconvenient or even impossible to execute the pre- and post–processing steps on substrates required for self-aligned patterning. Thus, a technique for selectively coating objects made of heterogeneous materials that avoids these stringent restraints would be a welcome advancement to thin-film patterning.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a spin dewetting technique that achieves the selective deposition of spontaneously-formed polymeric coatings on heterogeneous substrates without substrate pre-treatment or post treatment. This novel approach is enabled by spin coating, and selectivity is induced by polymer design that promotes preferential dewetting from one substrate material and uniform wetting on the other. As evidenced by studies with homogeneous surfaces, polyacrylates containing semi-fluorinated pendant groups spontaneously dewet from SiO_2 but form continuous films on Cu. When spin coated onto Cu/ SiO_2 line–space patterns, these semi-fluorinated polymers selectively coat Cu without any pre- or post-processing. Rational design rules that anticipate regimes of selective deposition have been developed, which connect the droplet size of dewetting structures on homogenous SiO_2 with the dimensions of heterogeneous Cu/ SiO_2 patterns. The universality of these rules is demonstrated across a library of polymers with varying molecular weight and monomer structure. This technology leverages the simplicity and rapidity of spin coating to reduce the entire patterning process to one step that is complete in under one minute.

ADVANTAGES

- Thin film deposition on imperfect, heterogeneous substrates
- No substrate pre- or post-treatment required
- Single step patterning process is complete in less than one minute

APPLICATIONS

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OTHER INFORMATION

KEYWORDS

spin-coating, thin-film, heterogeneous substrates, silicon, copper, polymer, electronics, semiconductor

CATEGORIZED AS

- **Semiconductors**
  - Assembly and Packaging
  - Design and Fabrication
  - Materials
  - Processing and Production

RELATED CASES

2019-964-0

- Integrated circuits
- Photonic devices
- Sensors
- Tailorable adhesion

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,738,366	08/29/2023	2019-964

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Selective Spin-On Deposition of Polymers

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