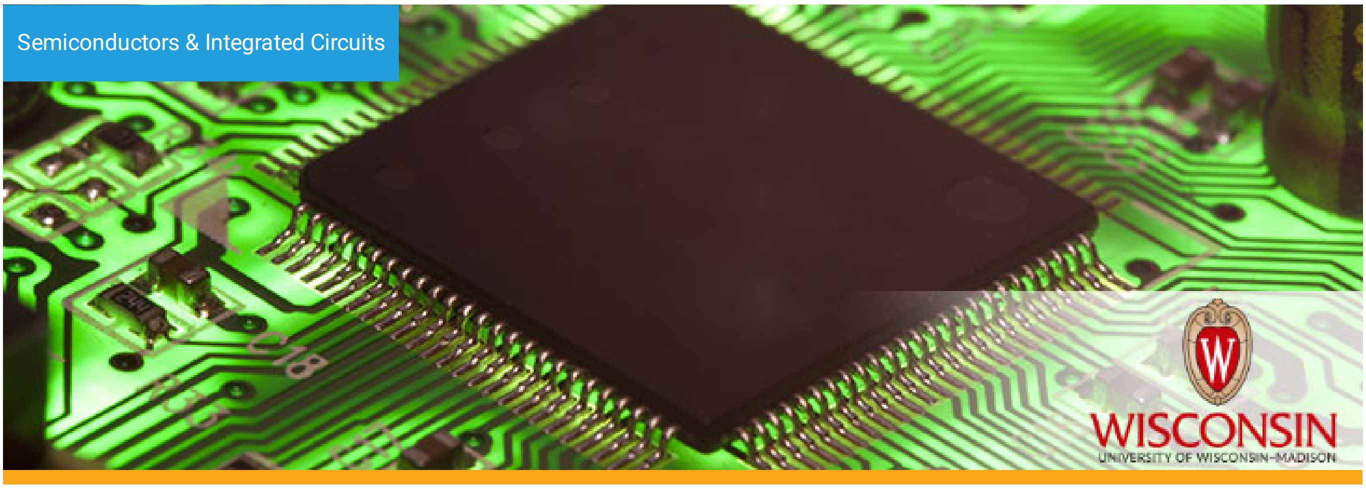

Method for Double-Sided Processing of Thin-Film Single-Crystalline Electronics

View U.S. Patent No. 7,354,809 in PDF format.

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing methods for fabricating active semiconductor devices on single-crystal semiconductor membranes and transferring these membranes to different substrates.

Overview

Future advances in semiconductor electronics for computers will require three-dimensional (3-D) integrated circuits that are not limited by the physics of thin film processing. In addition, flexible electronics will be important for other applications, such as solar cells, smart cards, radiofrequency identification (RFID) tags, medical applications and active-matrix flat panel displays. Integrating arbitrary layers of single-crystal semiconductors into these devices would offer numerous advantages, but currently, single-crystal semiconductors cannot be grown on the desired substrates.

The Invention

UW-Madison researchers have developed methods for fabricating active semiconductor devices, including thin-film transistors (TFTs) and more complex devices, on single-crystal semiconductor membranes and transferring these membranes to many types of substrates, including glass, plastics, Si, and other membranes. They also have developed methods for the two-sided processing of these single-crystal semiconductor membranes.

The methods start with a substrate that includes an active layer composed of a single-crystal semiconductor supported on a sacrificial layer. Device components are fabricated on the upper surface of this active layer. The active layer is released from the sacrificial layer, creating a thin single-crystal membrane that is transferred to a new host substrate. During the transfer process, the membrane containing devices on its upper surface is “flipped,” so the devices are on the bottom next to the host substrate. Additional device components can then be fabricated on the original lower membrane surface. The host substrate may become part of the electronic device, or it may temporarily support the active layer before it is transferred to an integration platform. The process can also be repeated, so that a stack of double-side processed membranes is created, leading to a new method of 3-D integration.

Applications

- LED and LCD displays
- RF tags
- Medical devices
- Other driving and sensing circuits

Key Benefits

- Results in high-speed, **single-crystal** devices on substrates such as glass, plastic, and highly thermally conducting materials, which conventionally require the use of polycrystalline or amorphous semiconductor materials.

- TFTs made in this manner are lightweight, flexible, robust and biocompatible, making them particularly useful in LED and LCD displays, RF tags, medical devices and other driving and sensing circuits.
- Device components can be integrated into upper and lower surfaces of the active membrane, yielding one-side or double-side integrated devices.
- More types of flexible-electronics devices can be fabricated than with conventional methods
- Transfer process allows quality of transferred active layers to be maintained, in contrast to other methods.
- Double-sided devices, such as double-gate field effect transistors and collector-up bipolar junction transistors/heterojunction bipolar transistors, can be easily and cost-effectively created without requiring thinning or polishing to expose the active layer.
- 3-D integrated circuits can be created from stacked membranes.

Additional Information

For More Information About the Inventors

- Paul Evans
- Max Lagally
- Zhenqiang Ma

Related Intellectual Property

- View Divisional Patent in PDF format.
- View Continuation Patent in PDF format.

Tech Fields

- Semiconductors & Integrated Circuits : Design & fabrication

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867