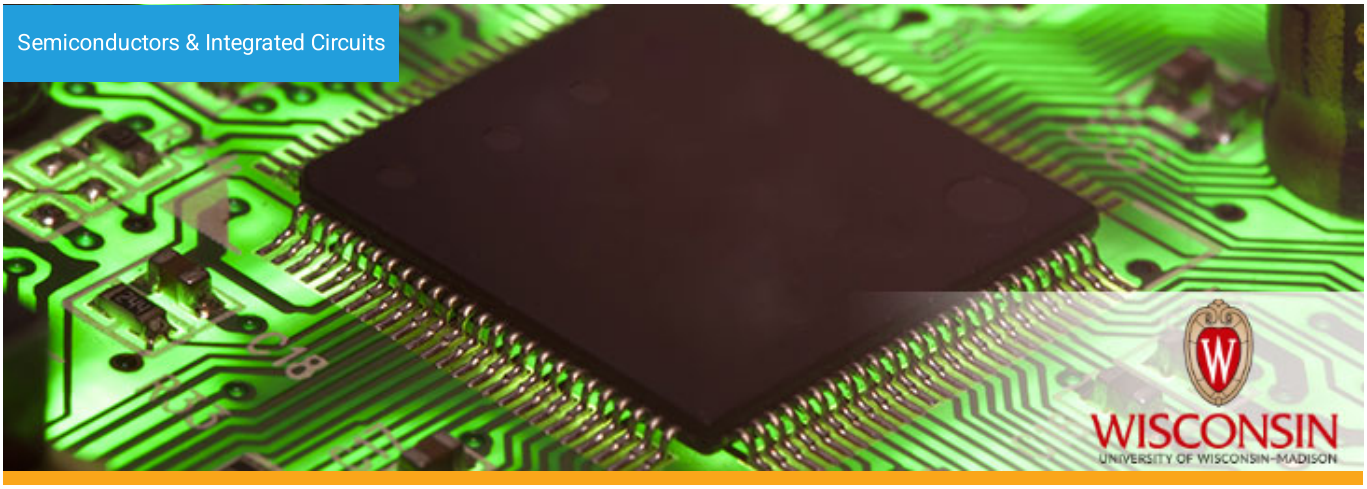
Semiconductors & Integrated Circuits



Flexible Thin-Film Transistors Are Doped and Strained

View U.S. Patent No. 9,006,785 in PDF format.

WARF: P130145US01

Inventors: Zhenqiang Ma, Max Lagally, Jung-Hun Seo

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing techniques to produce strain-sharing silicon nanomembranes for use in flexible electronics.

Overview

Fast, flexible electronics operating at radio frequencies (greater than 1 GHz) are attractive because of their versatility, power savings and wide applicability. Uses include wireless and high-speed communications, remote sensing and surveillance.

Device layers can be made of transferrable single-crystalline silicon nanomembranes. These flexible materials have desirable properties and are inexpensive. However, in contrast to rigid devices fabricated from bulk silicon, strain is a challenge. For truly high-speed devices, these nanomembranes must be doped to improve performance, freestanding and able to bear strain.

The Invention

UW–Madison researchers have developed doped semiconductor structures that share strain and enable thin, flexible transistors. The trilayer structures are made of single-crystalline semiconductor material like silicon and germanium.

The three-layered structure is grown epitaxially on a substrate and subsequently released. The first layer is selectively doped and comprises the same material and thickness as the third layer. This reduces the compressive or tensile strain typically borne by the middle layer.

Applications

- Electronics needing higher speed and mechanical flexibility
- Wireless communications
- Remote sensing
- Airborne/space surveillance

Key Benefits

- Strain is self-sustained and shared elastically between layers.
- No curling or buckling
- Transistors can have large areas but are very thin and mechanically flexible.
- Flexing (e.g., bending and rolling) does not hurt performance.
- Layer thickness of 100 nm
- Method is faster and requires less critical dimension scaling.

Additional Information

For More Information About the Inventors

- Zhenqiang Ma
- Max Lagally

Related Technologies

- WARF reference number P06456US describes an inexpensive process for making high-speed, thin-film transistors by transferring silicon layers from a bulk substrate to a flexible one.

Publications

- Zhou H., Seo J.-H., Paskiewicz D.M., Zhu Y., Celler G.K., Voyles P.M., Zhou W., Lagally M.G. and Ma Z. 2013. Fast Flexible Electronics with Strained Silicon Nanomembranes. Scientific Reports 3, 1291.

- View a news story about this technology.

Tech Fields

- Semiconductors & Integrated Circuits : Design & fabrication

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846