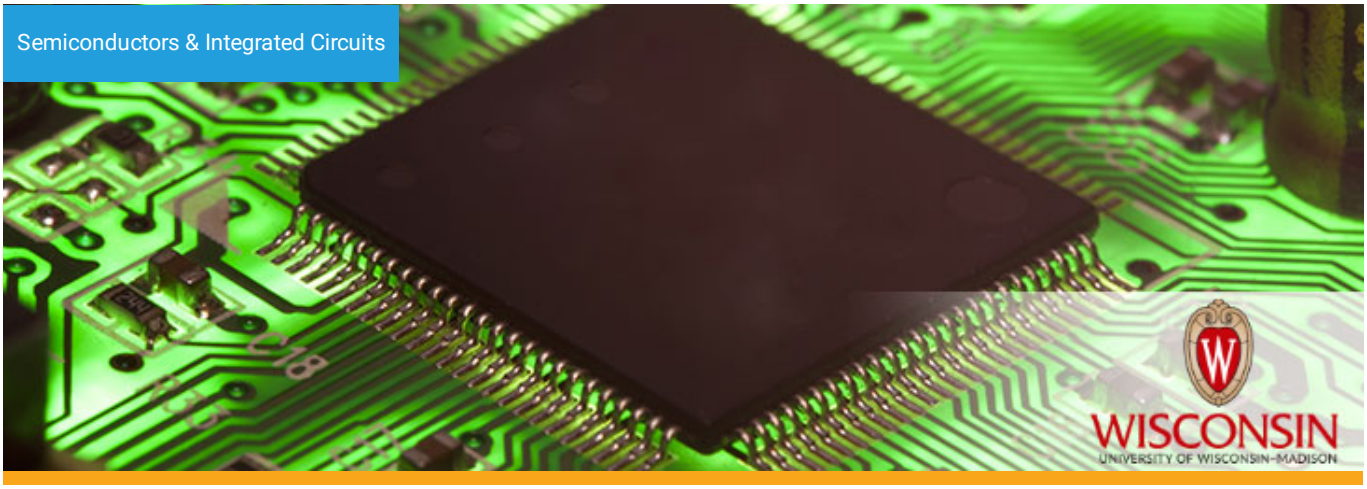
Semiconductors & Integrated Circuits



New Biodegradable Integrated Circuits Signal the Future of E-Waste Management

View U.S. Patent No. 9,437,628 in PDF format.

WARF: P150290US01

Inventors: Zhenqiang Ma, Yei Hwan Jung, Shaoqin Gong, Tzu-Hsuan Chang

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing biodegradable microwave electronics that can be used in consumer devices like smart phones and tablets, as well as methods for their production.

Overview

Electronic waste management remains an ongoing challenge both domestically and abroad. Scrap components of electronics such as computers, cellphones and refrigerators contain high amounts of heavy metals and hazardous materials like lead, cadmium, tin, gallium arsenide (GaAs) and brominated flame retardants.

While programs exist for recycling components and separating precious metals, 50-80 percent of waste products are exported to developing countries and openly burned or, in the case of the United States, left in landfills at a rate of 2 million tons per year.

The Invention

UW–Madison researchers have developed substantially biodegradable microwave integrated circuits and methods for their manufacture.

The circuits utilize cellulose nanofibril (CNF) thin-film paper rather than GaAs (a toxic semiconductor) as their principle substrate, minimizing amounts of potentially toxic inorganic materials. The CNF, which is derived from wood, is coated with a hydrophobic polymer to resist water and solvents while remaining readily degradable by common forest fungi.

Key electrical components, including a group III-V semiconductor, are formed on a standard substrate, which can be reused, and then transferred to the flexible, transparent and biodegradable CNF paper. The resulting circuits substantially reduce the levels of toxic materials introduced into the environment when they are discarded.

Applications

- Biodegradable electronics
- Flexible/wearable electronics
- Smartphones and tablets

Key Benefits

- CNF is biodegradable, flexible, transparent and has desirable electrical properties.
- Exhibits excellent high frequency performance
- Comparable to existing state-of-the-art electronics
- Reduces electronic waste
- Minimizes costs associated with e-waste management
- Reduces the use of costly and hazardous materials like GaAs

Stage of Development

The assembly of thin-film microwave devices with excellent high frequency performance has been demonstrated using this technique.

Additional Information

For More Information About the Inventors

- Zhenqiang Ma
- Shaoqin Gong

Related Technologies

- WARF reference number P150093US01 describes high performance thin-film radiofrequency transistors for use in flexible electronic devices.
- For more information on doped semiconductor structures that share strain and enable thin, flexible transistors, see WARF reference number P130145US01.

Publications

- Jung et al. 2015. High-Performance Green Flexible Electronics Based on Biodegradable Cellulose Nanofibril Paper. Nat. Commun. 6.
- Hwang et al. 2013. Materials for Bioresorbable Radio Frequency Electronics. Adv. Mater. 25, 3526–3531.

- Read a news story about this technology.

Tech Fields

- Semiconductors & Integrated Circuits : Components & materials
- Semiconductors & Integrated Circuits : Design & fabrication

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