

PURDUE UNIVERSITY DISCOVERY PARK

Scalable Nanomanufacturing for the Internet of Things (IoT)



Birck Nanotechnology Center - Discovery Park - Purdue University

The "Internet of Things" envisions intelligence and communication built into all kinds of consumer products as well as creating a digital thread during the whole life-cycle from manufacturing and distribution to maintenance and recycling.

Leading Research Initiative

Purdue's Birck Nanotechnology Center in Discovery Park is leading a research initiative with two dozen faculty across ten Schools and four Colleges to advance IoT in functional printing, microsystem integration with ultraflexible chips, sensors in harsh environments and scalable nanomanufacturing to overcome IoT implementation challenges.

With Purdue's strengths in engineering, composites, agriculture, science and the health and food sciences there is particular interest in focusing efforts on smart thin film devices which could enable revolutionary products in ► structural health monitoring ► adaptive antennas ► personalized medicine where medication release rates are controlled by physiological conditions, and ► food packaging that records the temperature history of the product, detects spoilage, and communicates the information to the cloud.

Effective Energy Harvesting

Most IoT applications require effective energy harvesting schemes as batteries are often undesirable or impractical. Purdue has already developed a variety of solutions based on far- and near-field RF powering as well as vibration-based schemes. Furthermore, relevant solutions in high-temperature condition-monitoring applications such as bearing sensors have been successfully demonstrated with high reliability.

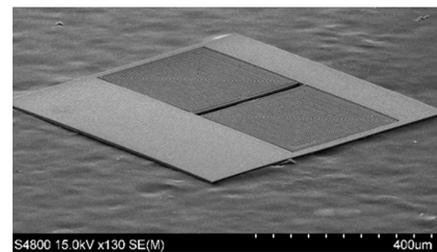
Capabilities

The Birck Nanotechnology Center provides unique capabilities dedicated to advancing discovery in IoT. Close collaborations among diverse faculty experts at Purdue has opened up transformational opportunities for this major research area.

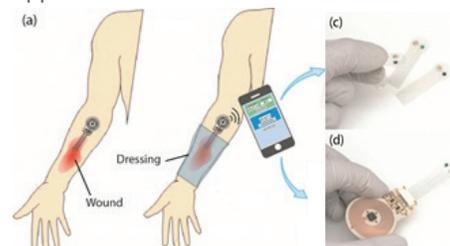
- Leading researchers in MEMS and RF IC design, nanobio sensors and organic materials are part of the team of experts;
- A state-of-the-art nanofabrication and characterization facility;
- New labs and a series of small scale nanomanufacturing machines;
- 40 ft. long functional film processing with local control of anisotropic electrical, magnetic, thermal and dielectric properties;
- A roll-to-roll (R2R) plasma chemical vapor deposition;
- R2R inkjet/laser processing.
- An HP Printing Center specialized in hardware and software needed for manufacturing quality control is also at Purdue.

Industry Consortium

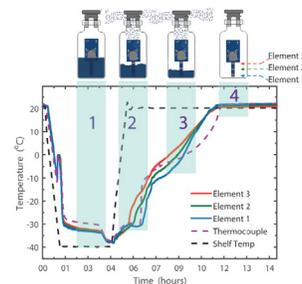
Tool manufacturers and application industries are partnering with Purdue to help facilitate the IoT path to commercialization. Initial projects are focused on thin film RFID integrated with sensors, radiation detectors, pressure sensitive surfaces, smart wound healing, soil nutrient sensors and smart food packages.



A dust size (0.5 mm²) self-powered wireless transceiver with sensor interface for IoT applications.



Schematic of the flexible wireless wound pH monitoring system utilizing NFC communication. Sensor (c) NFC wireless (d).



Wireless sensor technology to advance pharmaceutical manufacturing. The figure shows the measured temperature profile of the vial contents under a test freeze drying cycle for a single sensor.



Microgravure/slot die coating machine in the Birck Nanotechnology Center.