Sensor Commercialization Challenges:
Small Business Frustrations Involving Nanomaterial Regulations

Dr. Stephen E. Gibbons
Technology Director, Carbon Electronics
Brewer Science, Inc.

Sensor fabrication, integration, and commercialization workshop

9.11.14
Sensors Meeting Industry Needs Are Ready Today

- Response of humidity sensor
- Response of temperature sensor
- Breath monitoring sensor

$> 10^2$ times faster than existing state-of-the-art capacitive-type sensors
Frustration

Carbon nanotubes, as well as many other advanced nanomaterials, are an integral part of the future of sensor development.

Unfortunately, there is a wall restricting the commercial use of many of these nanomaterials.
Biggest need: Identifying what areas associated with nanomaterials should be considered prior to commercial use
Market Grouping: Composites vs. Sensors

**Composites**
Carbon nanotubes used in cement:
1000-2000 g CNTs per metric ton
Roughly a 10’ × 6’ × 3” slab
Stay as nanoparticles after deposition

**Sensors**
< 100 pg of CNTs per device
Exists as micro- and millisize particles after deposition

Difference in CNT concentration for these two applications is > 1,000,000,000,000 times
Where Are We?

We are here in the Inflection Point, which represents a critical point of change. The curve to the left shows a decline in business, characterized by restrictions, no clear process, and indecisiveness. The curve to the right shows an upward trend, with freedom, defined process, and decisiveness leading to a clear roadmap and a call to action.

Nanomaterial-Enabled Sensors:

Business Declines:
- No clear process
- Indecisiveness
- Inaction

Business Reaches New Heights:
- Freedom to practice
- Defined process
- Clear roadmap
- Call to action
Summary

What is it going to take?

Can all of the players come to a consensus?

Are we content watching others pass U.S. by?

How can we help make this happen?

I’m so glad we all agree.
Leading innovation and manufacturing

As a privately held company, Brewer Science has achieved and sustained unprecedented growth for over three decades by commitment to the customer, strong focus on innovation, and significant investment in R&D, instead of by solely focusing on shareholder returns.

- Exceptional expertise in advanced polymeric thin-film materials and their integration into microelectronics processing
- Trusted supplier to top semiconductor manufacturers for over 30 years
Brewer Science

at a glance

• Founded in 1981 by Dr. Terry Brewer
• Inventor of ARC® materials for advanced lithography
• Market leader for bottom anti-reflective coatings for over 30 years
• Diverse product portfolio with hundreds of U.S. and international patents
• Headquarters: Rolla, Missouri, USA
• Technical support, business offices, and distribution in North America, Europe, and Asia
Enabling reliable fabrication of cutting-edge microelectronics
Where innovation takes flight!sm

brewersscience.com