

Sensor Commercialization Challenges: Small Business Frustrations Involving Nanomaterial Regulations

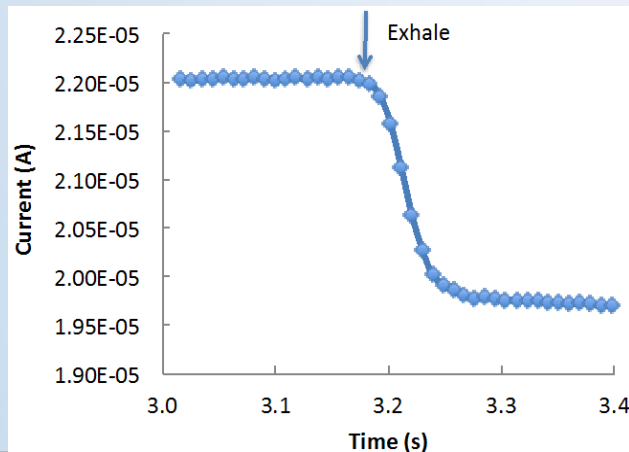
Dr. Stephen E. Gibbons
Technology Director, Carbon Electronics
Brewer Science, Inc.

Sensor fabrication,
integration, and
commercialization
workshop

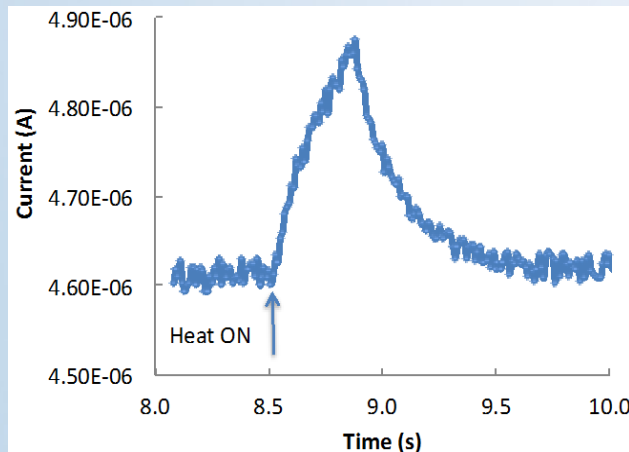
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Sensors Meeting Industry Needs Are Ready Today

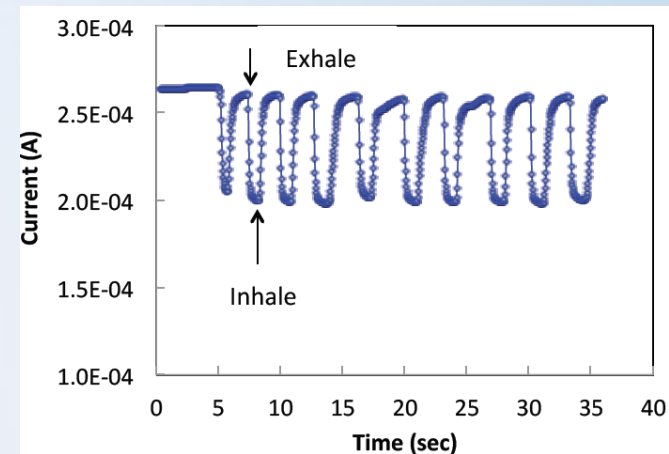


Response of humidity sensor



Response of temperature sensor

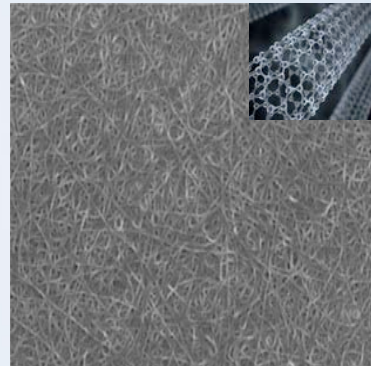
> 10^2 times faster than existing state-of-the-art capacitive-type sensors



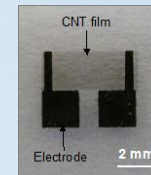
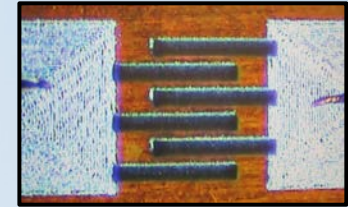
Breath monitoring sensor

Frustration

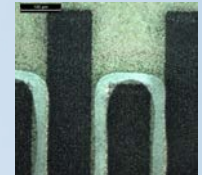
Carbon nanotubes, as well as many other advanced nanomaterials, are an integral part of the future of sensor development



Bio

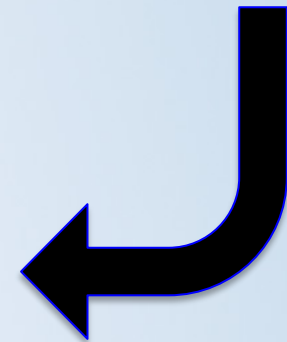


Physical

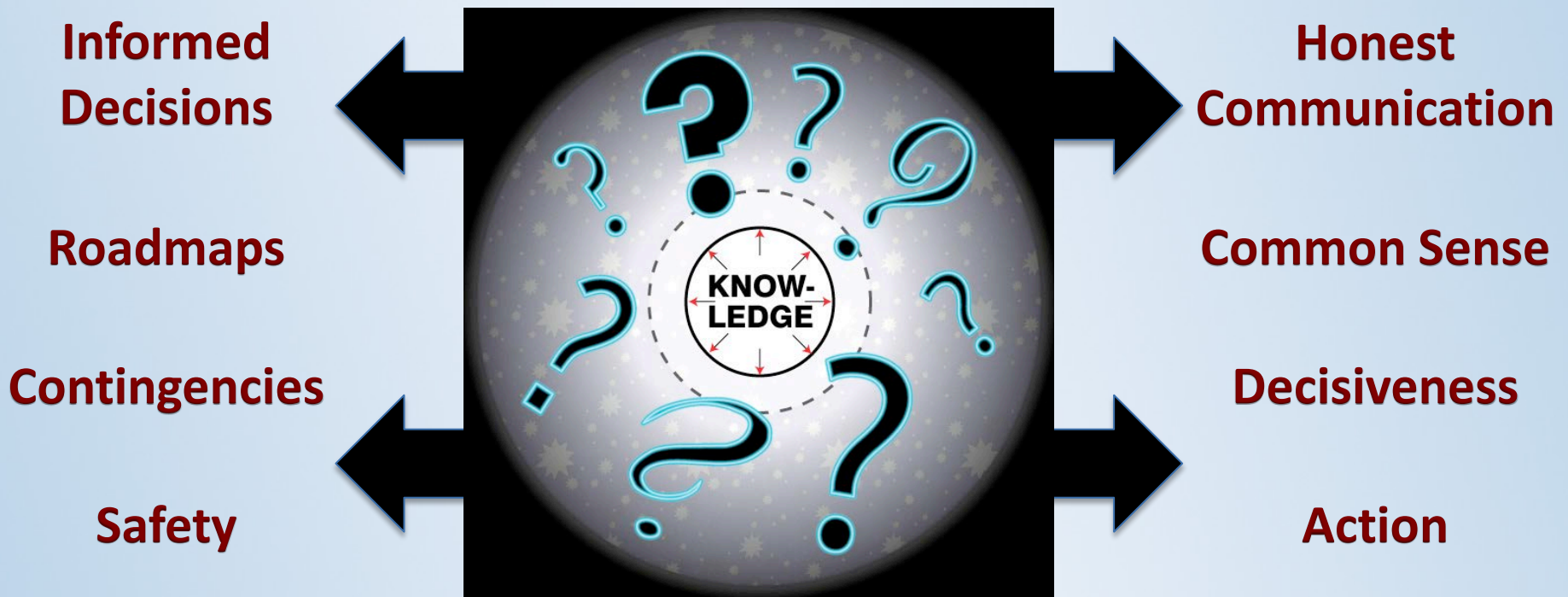


Chemical

Unfortunately, there is a wall restricting the commercial use of many of these nanomaterials



Risk and Uncertainty Factors vs. Decisions



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

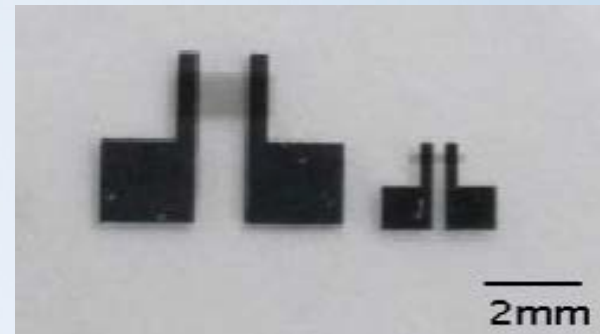
Stay as nanoparticles after deposition



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?

The Inflection Point Curve

- Andy Grove

Business Reaches
New Heights

freedom to practice
defined process

clear roadmap

call to action

decisiveness

We are
here

restrictions

no clear process

no clear roadmap

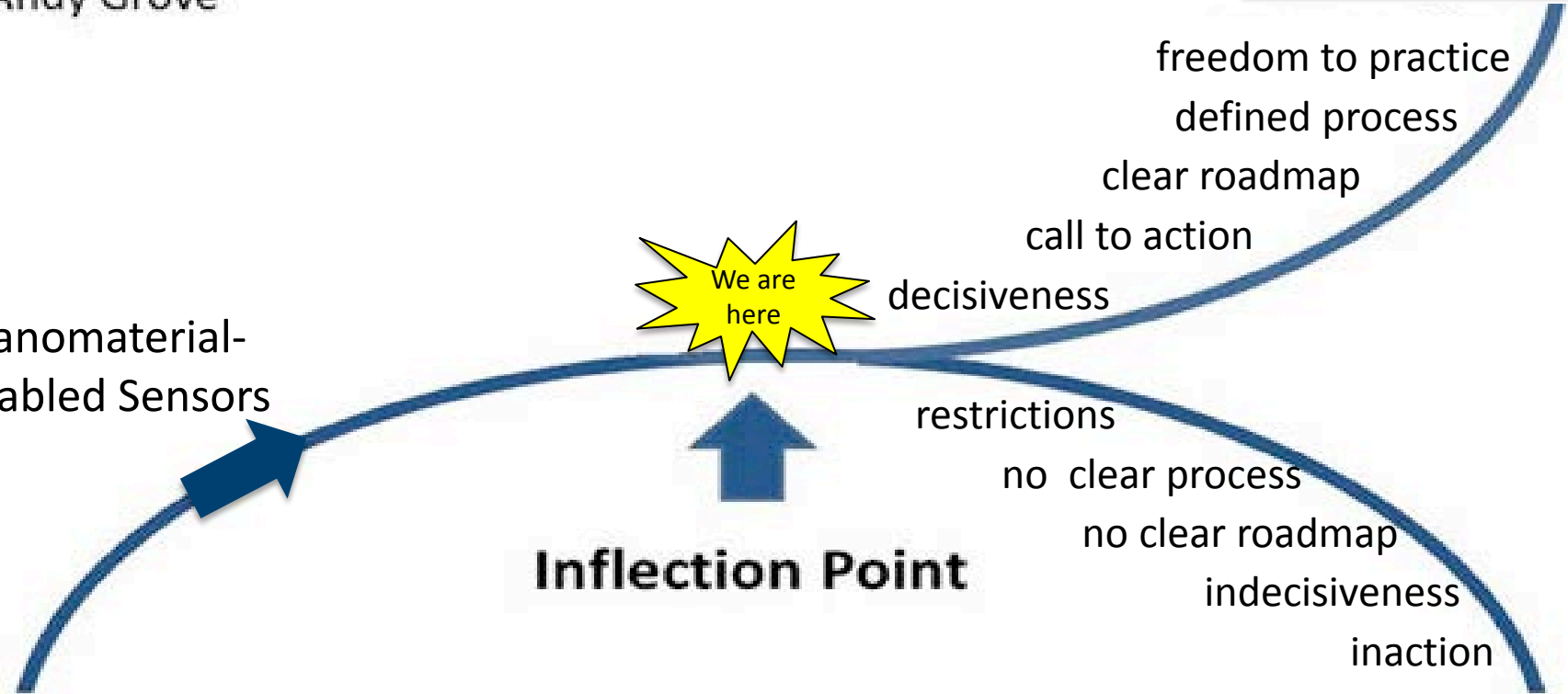
indecisiveness

inaction

Business
Declines

Nanomaterial-
Enabled Sensors

Inflection Point



Summary



What is it going to take?



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



Can all of the players come to a consensus?

I'm so glad we all agree



How can we help make this happen?



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- Exceptional expertise in advanced polymeric thin-film materials and their integration into microelectronics processing
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- 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



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