



# Food Nanotechnology: Food Packaging Applications

Tara McHugh  
Processed Foods Research Unit



Processed Foods Research Unit  
Western Regional Research Center  
Albany, CA

# Market for NanoFoods



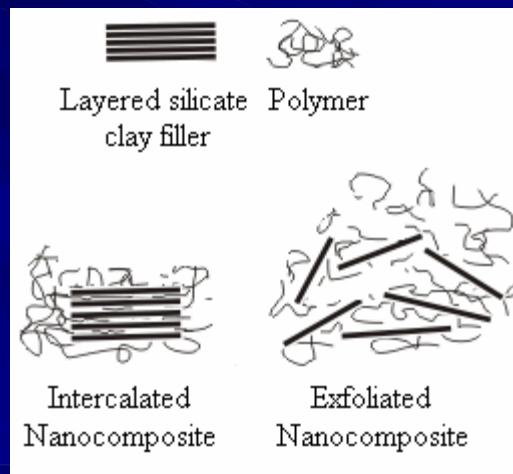
- **Current Market of \$2.6 Billion**
- **Predicted Market of \$20.4 Billion in 2010**
- **Current Market for Nanotechnology in Food Packaging is Expected to Reach \$360 Million in 2008**

# Why Predicted Market Growth?

- **Extraordinary Benefits Offered through Application of Nanoscience to Food Packages**
- **Improvements in Mechanical Properties**
- **Better Barrier Properties**
- **Antimicrobial Benefits**
- **Stability Improvements**
- **Intelligent Packaging**

# Nanocomposite Packaging

## Structures of Layered Silicate Clays



# Nanocomposite Packaging

## Preparation Methodologies

- **Solution Method**
- **In situ / Interlamellar Polymerization Technique**
- **Melt Processing**



# Durethan, Bayer Polymers

## Thermoplastic Polyamide Nanocomposite

- Large Amount of Silicate Nanoparticles
- Used in Flexible Films and Paper Coatings
- Reduce Entrance of Oxygen and Exit of Moisture
- Prevent Food Spoilage





*Leading-Edge Developer of Nanoclay Technologies for Plastics*

# Nanocor

## Nanocrystals Used in Nanocomposites

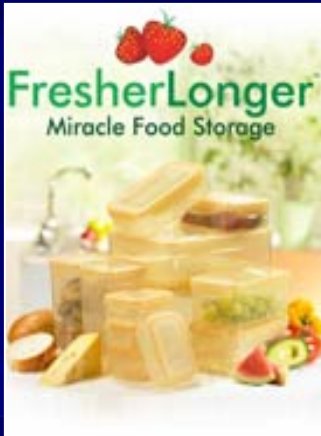


- Imperm
- Plastic Beer Bottles (PET)
- Minimize Loss of Carbon Dioxide and Entrance of Oxygen into Bottles



# Active Packages

## Antimicrobial Nanoparticles in Packaging



- Infused with Antimicrobial Silver Nanoparticles
- Sharper Image
- Other Antimicrobial Compounds Include Magnesium Oxide and Zinc Oxide

# Intelligent Packages

## Addition of Nanosensors to Packaging



- Nanosensors to Detect Chemicals, Pathogens and Toxins in Foods

- Porous Silicon and Carbon Nanotube Based Sensors



NanoSensors Inc.

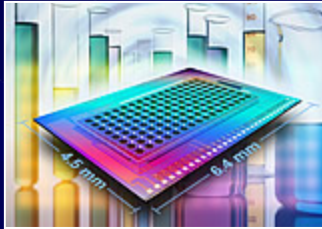
# Intelligent Packages

## Addition of RFID to Packaging



- Do Not Require Line-of-Sight for Reading
- Enable Registration of Hundreds of Tags per Second

**WAL★MART®**



# Intelligent Packages

## DNA Biochips

- **Hundreds or Thousands of Short Strands of Artificial DNA Deposited Precisely on a Silicon Circuit.**
- **Each DNA Strand Acts as a Selective Probe. When it Binds to Material in a Sample an Electrical Signal is Recorded**
- **Detect Pathogens in Foods**
- **Improve Food Safety and Security**
- **Portable Devices Under Development**



# Intelligent Packages

## Carbon Nanotubes Coated with DNA

- Researchers at U. Penn., Dr. Johnson
- Detect Specific Odors and Tastes
- Electronic Tongue or Electronic Nose
- Detect Molecules on Order of One Part Per Million

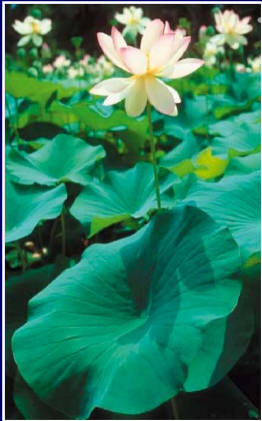


Helping Make  
Products Better™

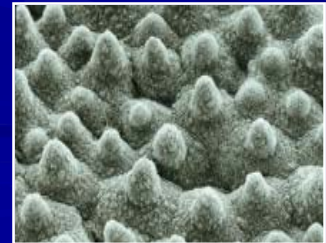
 **BASF**  
The Chemical Company

# Water and Dirt Repellent Packages

## Lotus Effect

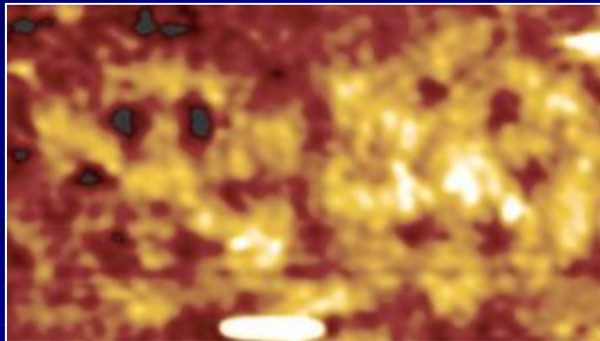


- No Surface Area for Drop to Stick To
- BASF Spray on Coating for Rough Surfaces to Make Them Repel Water and Dirt
- Used on Cardboard



# Nano Wheels

- Self Assembled Wagon Wheel, 7 nm in Diameter
- Now Attempting to Grow Structures Resembling Spider Webs
- Potential to Improve Food Packaging Materials



# Polymer Opal Films

- Self Assembled Structures
- Arrays of Spheres Stacked in Three Dimensions
- Can Contain Carbon Nanoparticles
- Change Color to Indicate When Food is Spoiled



***“The future belongs to those who believe  
in the beauty of their dreams.”***

**Eleanor Roosevelt**