Emerging Fields of

Nanotechnology

Background

- **Government, industry and science have identified the potential of nanotechnology in the food and agriculture sectors and are investing significantly in the application to food production.**

Background continued…

- However, owing to limited knowledge of the effects of these applications on human health, the need for early consideration of the food safety implications of the technology is recognized by stakeholders.

Nanotechnology

Applications

Opportunities for the development of innovative products and applications:

- Agriculture
- Water Treatment
- Food Production
- Processing
- Preservation
- Packaging

Nanotechnology Benefactors:

- Farmers
- Food Industry
- General Consumers

Availability

- Nanotechnology –based food and health food products, and food packaging materials, are available to consumers in *some* countries already and additional products and applications are currently in the research and development stage. Some of these products may reach the market soon.
- In view of such progress, it is expected that nanotechnology –derived food products will be increasingly available to consumers worldwide in the coming years.

Novel Properties & Relevant Applications of

Nanomaterials

Chemical:

Enhancement Factor

- **Increment of their surface are that increases the chemical activity.**

Application

- **Catalyst for noxious and toxic gases**
- **fuel cells using bimetallic nanoparticles.**

Mechanical:

Enhancement Factor

- **Reduction in grain size increases fatigue life. Possess good formability and machinability. Porous and extremely lightweight materials.**

Application

- **Tougher and harder cutting tools, rocket engines, thrusters, and vectoring nozzles;**
- **ductile, machinable ceramics some with superplastic behavior**
- **better insulation materials, like aerosols and smart (ability to respond to change in their surroundings) windows, which darken when the sun is too bright and lighten themselves otherwise.**

Optical:

Enhancement Factor

- Quantum confinement of electrical carriers
- Efficient energy and charge transfer over nanoscale distances
- Highly enhanced role of interfaces

Application

- Casings to improve shielding against electromagnetic interference
- Glues for use in optoelectronics

Electrical/electronic:

Enhancement Factor

- Due to their large grain boundary (surface) area, they can hold considerably more energy
- Optical absorption band can be introduced or an existing band can be altered

Application

- High energy density batteries that require far less frequent recharging and last much longer
- Large electrochromic display devices

Magnetic:

Enhancement Factor

- **Coercivity and saturation magnetization increases with a decrease in the grain size and an increase in the specific surface area**

Application

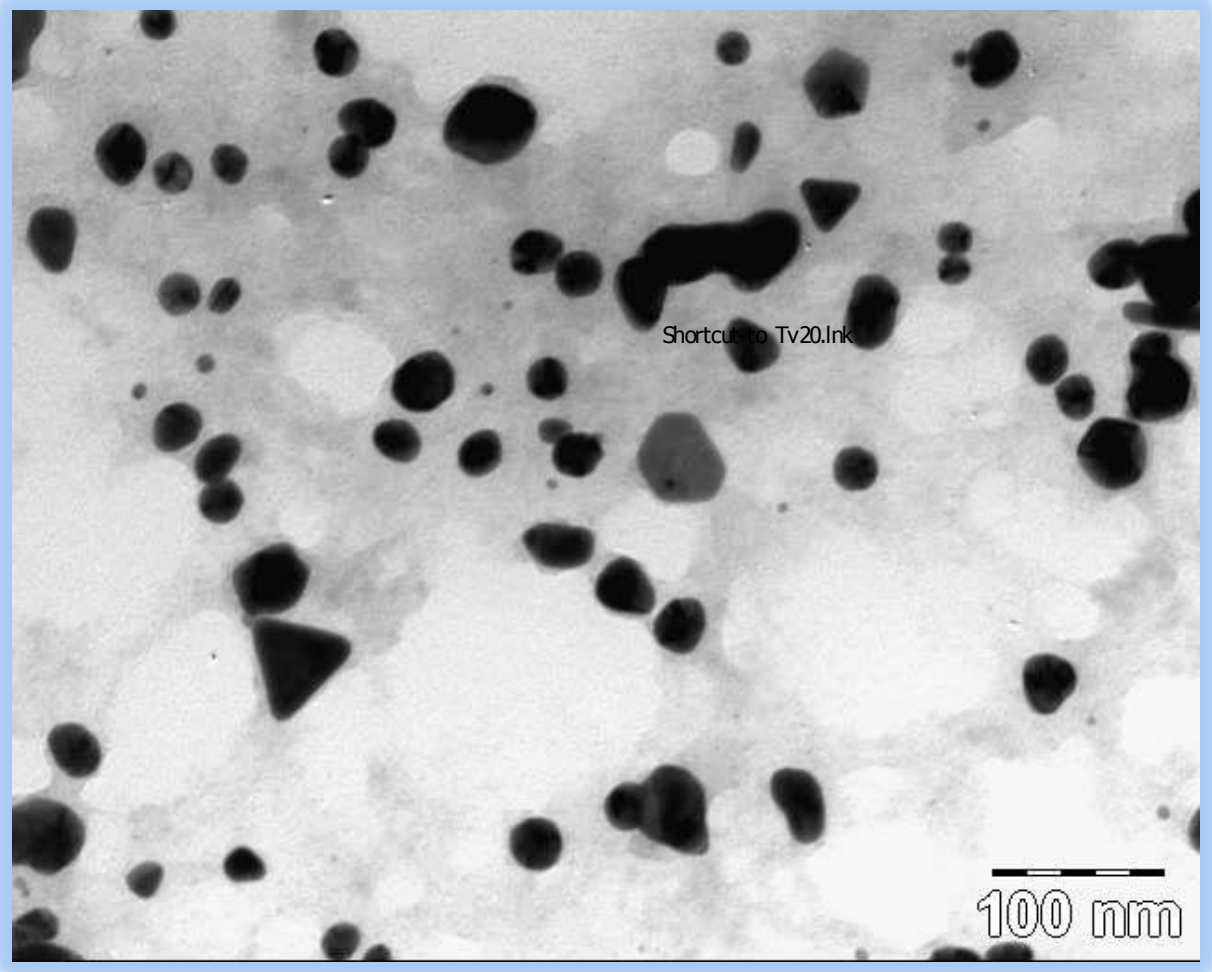
High-power rare-earth magnets for:

- **quieter submarines**
- **automobile alternators**
- **Land-bases power generators**
- **Ultrasensitive analytical instruments**
- **Magnetic resonance imaging (MRI)**

Biological:

Enhancement Factor	*Application*
• Improved permeability • Enhanced adsorption of proteins	• Permeability through biological barriers • Improved biocompatibility • Targeted drug delivery

TEM Images of Gold Nanoparticles



Gold Nanoparticles