

# Bulk Materials Nanotechnology FAQs

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## ▶ What is materials nanotechnology?

There are 2 types of materials nanotechnology

- Particulate Materials Nanotechnology – used as catalysts, pigments, UV Absorption, waterproof fabric coatings for industries such as glass, paint and textiles; in polymers; to deliver drugs; and as nano machines in electronic products
- Bulk Materials Nanotechnology – shrinking the microstructure scale (i.e. phase and grain size) to a nanoscale
  - NanoSteel is Bulk Materials Nanotechnology

## ▶ What is the length of scale of materials nanotechnology?

Nanotechnology materials are ordered on a nanoscale – 10 to 100 nanometers

- One nanometer (nm) is one billionth of a meter (1 meter = 3.28 feet)
  - Ant is 5 million nm
  - Head of a pin is 1 million nm
  - Width of a human hair is 100,000 nm
  - Red blood cell is 3,000 nm

## ▶ What are the benefits of Bulk Materials vs. Particulate Materials Nanotechnology?

Manufacturing

- Particulate Materials Nanotechnology – High Cost
  - Expensive exotic raw materials are used in product composition
- Bulk Materials Nanotechnology – Similar to Conventional Materials
  - Widely available raw materials are used in product composition, no exotics

Ease of Use

- Particulate Materials Nanotechnology – Complex
  - Can require specialized technology, equipment and facilities for use
- Bulk Materials Nanotechnology – Easy
  - Used with existing and widely available commercial systems

Health

- Particulate Materials Nanotechnology – Currently being determined
  - Issues may exist with human absorption of particles
- Bulk Materials Nanotechnology – No special issues
  - Particles are conventional in size, only microstructure is nanoscale

## ▶ How do NanoSteel alloys achieve better performance than conventional alloys?

NanoSteel alloys provide an innovative solution to a hardness/toughness materials paradox

- Previously in conventional alloy development, increasing hardness to improve wear performance made an alloy brittle (less tough or ductile) or increasing toughness (ductility) decreased hardness and reduced wear performance
- When applied as metallic coatings, NanoSteel alloys feature a microstructure with grain sizes refined to a nanoscale which results in increased hardness *and* toughness with improved wear performance

Conventional Metallurgy vs. Unconventional Metallurgy

- In Conventional Metallurgy, product chemistry provides most of a product's performance characteristics
- In Unconventional Metallurgy, NanoSteel alloys utilize product chemistry and a crystalline microstructure refined to a nanoscale to significantly boost performance

## ▶ NanoSteel alloys are iron based steel, why is this a competitive advantage?

Iron based steel alloys are:

- Environmentally friendly and high recyclable materials
- Produced with widely available raw materials, no exotic or strategically critical materials are utilized
- Manufactured with well understood methods utilized in most major industries
- Easy to use and applied with existing and widely available commercial systems
- Used for a wide variety of industrial applications, resulting in lower raw material production costs, lower manufacturing costs and lower prices for many everyday consumer goods

## ▶ How do NanoSteel alloys compare on a price basis to existing alloys?

Because the material chemistry is iron based, in most cases NanoSteel alloys provide a significant advantage on a cost-for-performance basis