

# Nanotechnology in Grease



## Advancing Lubrication with Nano-Enhanced Performance

Nanotechnology has emerged as a transformative force in the lubrication industry, offering groundbreaking solutions for performance and durability. In this bulletin, we will explore the fundamentals of "nano" and its application in grease formulations. By incorporating advanced nanoparticles such as tungsten disulfide ( $WS_2$ ), hexagonal boron nitride (hBN), and molybdenum disulfide ( $MoS_2$ ), nano-enhanced greases deliver superior anti-friction (AF), anti-wear (AW), and extreme-pressure (EP) properties—achieving exceptional results with remarkably low treat rates.

### Nano - It's Just a Size

1 micron ( $\mu m$ ) = 1 micrometer = 1/1000 millimeters

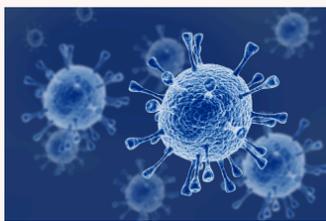
1 nanometer (nm) = 1/1000 micrometers/microns ( $\mu m$ )

**nano** is called 1-100nm size

**sub micron** is called 101-99nm size



nano scale examples:  
Atoms, molecules



sub micron scale examples:  
some viruses and small bacteria



micron scale example:  
single human hair is  
approximately 100 microns  
(0.1 millimeter)

### Traditional vs Nano Enhanced Grease

#### TRADITIONAL GREASE

- Multiple additives required
- Limited performance under extreme pressure (EP)

**VS**

#### NANO ENHANCED GREASE

- Incorporates nano & submicron particles. Large surface area – enables low treat rate
- Superior anti-friction (AF), anti-wear properties (AW), extreme pressure (EP), shock absorbing, thermal conductivity properties



## Nanotechnology in Grease

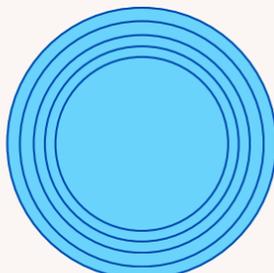
**Definition:** Use of nano (1-100nm) and submicron particles (101-900nm) in formulations

**Mechanism:** Particles act as miniature ball bearings and/or multilayered 2D solids, reducing friction, generating a tribofilm on a surface and protection from micropitting

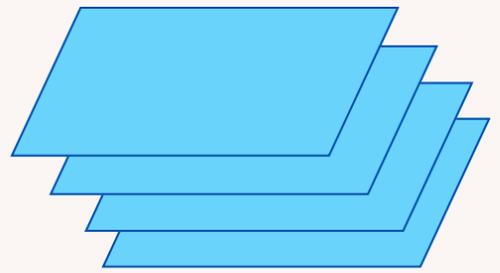
**Benefits:** Enhanced stability, performance, and longevity



**Solid Cristal**  
AlO<sub>3</sub>, TiO<sub>2</sub>, DLC, etc.



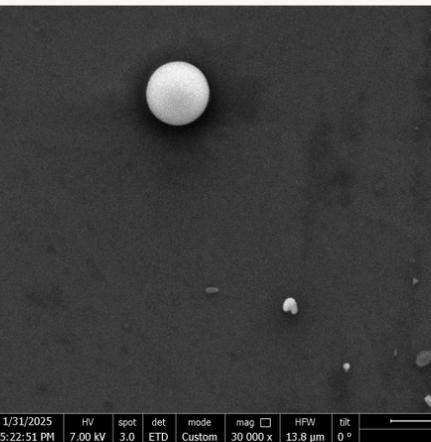
**Multilayered, hollow core**  
C60, WS<sub>2</sub>, etc.



**Multilayered platelete**  
Graphite, MoS<sub>2</sub>, WS<sub>2</sub>, etc.

## Nanotechnology in Grease

### Hexagonal Boron Nitride (HBN)



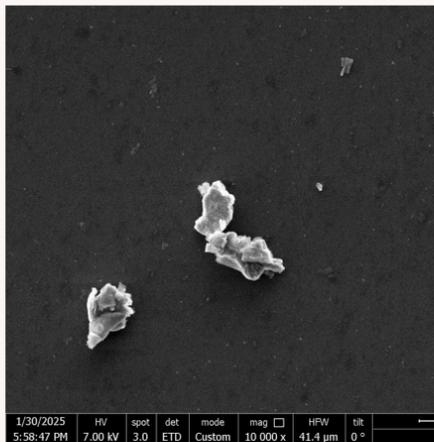
**Properties:**

- High thermal conductivity
- Good lubricating properties similar to graphite

**Function:**

- Stabilizes temperature fluctuations in the grease
- Enhances thermal management

### Molybdenum Disulfide (MoS<sub>2</sub>)



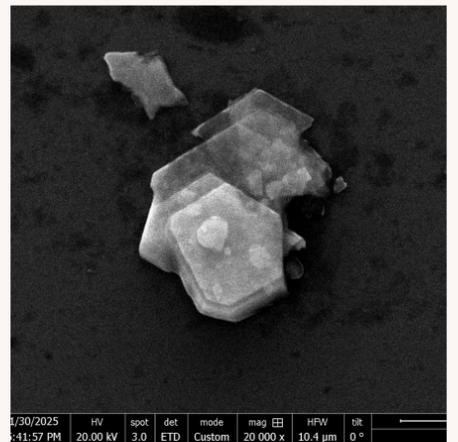
**Properties:**

- Excellent anti-wear characteristics
- Effective load-carrying capacity

**Function:**

- Forms a protective layer under stress
- Minimizes metal-to-metal contact

### Tangsten Disulfide (WS<sub>2</sub>)



**Properties:**

- Layered structure with low friction
- Excellent extreme pressure performance

**Function:**

- Reduces friction and wear even under heavy loads
- Provides excellent EP properties

## Formulation

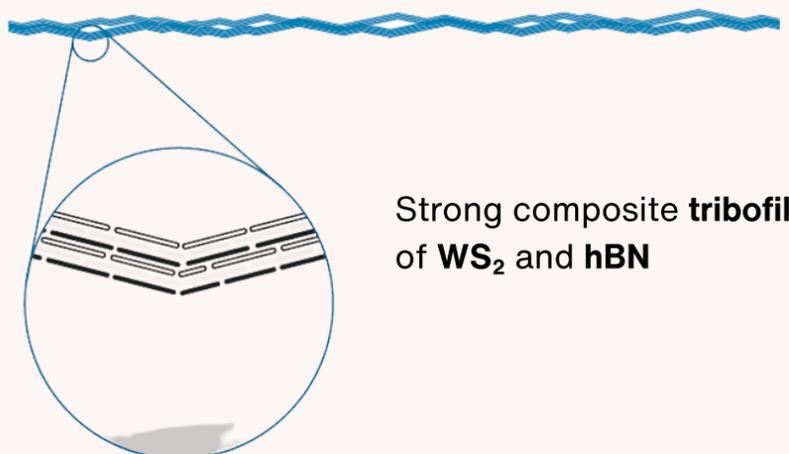
Revolutinazing grease formulation

**Integration:**

- Blending nano and sub micron additives with traditional grease matrices
- Synergistic effects when combining WS<sub>2</sub>, hBN

**Impact:**

- Improved longevity and reliability
- Customizable formulations for specific applications



Strong composite **tribofilm** of WS<sub>2</sub> and hBN